WILTRON

MODELS
6759A AND 6759A-10
SWEPT FREQUENCY SYNTHESIZER

MAINTENANCE MANUAL

WILTRON

490 JARVIS DRIVE • MORGAN HILL, CA 95037-2809
(408) 778-2000 • TELEX 285227 WILTRON MH • FAX 408-778-0239

P/N: 10370-00062
REVISION: C
PRINTED: NOVEMBER 1989
COPYRIGHT 1988 WILTRON CO.

WARRANTY

All WILTRON products are warranted against defects in materials and workmanship for one year from the date of shipment, except for YIG-tuned oscillators, which are warranted for two years. WILTRON's obligation covers repairing or replacing products which prove to be defective during the warranty period. Buyers shall prepay transportation charges for equipment returned to WILTRON for warranty repairs. Obligation is limited to the original purchaser. WILTRON is not liable for consequental damages.

LIMITATION OF WARRANTY

The foregoing warranty does not apply to WILTRON connectors that have failed due to normal wear. Also, the warranty does not apply to defects resulting from improper or inadequate maintenance by the Buyer, unauthorized modification or misuse, or operation outside of the environmental specifications of the product. No other warranty is expressed or implied, and the remedies provided herein are the Buyer's sole and exclusive remedies.

IMPORTANT

Dear Customer:

To better serve you, WILTRON Company is now mailing change pages directly to our manual holders.

To receive future change pages, remove this page from your manual, fill out, detach, and return the self-addressed card below (no postage necessary, when mailed in the United States).

Thank You,
WILTRON Company

Tear Here

***Mail TODAY;
no postage
required in
U.S.A.***

WILTRON

____ I *recommend* purchase of equipment/instruments.

____ I *authorize* purchase of equipment/instruments.

The following were influential in my choice of WILTRON products:

- ____ Magazine advertisements
- ____ Direct mailings
- ____ Personal recommendation
- ____ Visit from sales rep.
- ____ Other ____________________

____

MANUAL REGISTER

Fill in manual number and Rev. :
P/N 10370-00062 C
(Manual number is located in the lower right corner of title page.)

Please print.

Name ____________________
Title ____________________
Company ____________________
Address ____________________
City ____________________
State ____________ Zip ____________
Country ____________________
Phone ____________ Ext. ____________

P/N: 00986-00001
REV: D

MR-1084

No
Postage Stamp
Necessary
If Mailed in the
United States

BUSINESS REPLY MAIL

First Class Permit No. 2, Morgan Hill, CA

WILTRON Company
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

TABLE
OF
CONTENTS

Tab / Section Title

1 GENERAL INFORMATION

Section I contains a general description of the WILTRON 67XXA Swept Frequency Synthesizer, the equipment identification number, manuals supplied, performance specifications, and options. A list of recommended test equipment used for Performance Tests, Calibration/Adjustments and Troubleshooting is also included.

2 PERFORMANCE VERIFICATION

Section II contains procedures used to verify the performance of all models of 67XXA Swept Frequency Synthesizer to specifications. These procedures cover all units having any version of firmware. A list of recommended test equipment used for these procedures is also included.

3 CALIBRATION / ADJUSTMENTS

Section III contains procedures used to calibrate and/or adjust all models of 67XXA Swept Frequency Synthesizers. These procedures are typically performed as a result of out-of-tolerance conditions having been noted during performance verification testing (Section 2), or as a result of the repair or replacement of printed circuit assemblies or microwave components.

4 TEST RECORD

Section IV contains two Test Record tables used for recording the results of the Performance Verification (Section 2) Tests and/or the Calibration/Adjustment procedures (Section 3).

5 PARTS LISTS

Section V contains Parts Lists for all major assemblies and printed circuit assemblies of the model 67XXA (including microwave deck components). The parts lists for the major assemblies include photo and line art illustrations for ease of component identification.

6A SERVICE INTRODUCTION

Section VI–Service is comprised of 16 subsections, A–N, P and Q. Subsection 6A contains general information pertaining to all of the subsections in Section VI. It also contains a detailed Table of Contents for these subsections.

6B THEORY / BLOCK DIAGRAM

This subsection contains a theory of operation for the overall operation of the model 67XXA. It also includes a generic overall block diagram of the 67XXA Swept Frequency Synthesizer.

6C TROUBLESHOOTING

This subsection contains an all-inclusive Table of Error Codes for all 67XXA models. It also contains a listing of hidden-key functions for use as a troubleshooting aid.

6D thru 6Q TROUBLESHOOTING SECTIONS

Subsection 6D thru 6Q contain specific troubleshooting information for the 12 subsystems that comprise the model 67XXA. Each subsection contains a detailed theory of operation, block diagrams, schematic diagrams and parts locator diagrams for the PCBs that comprise a particular subsystem.

TABLE
OF
CONTENTS (Continued)

Tab / Section Title

7 DISSASSEMBLY AND REPAIR PROCEDURES

Section VII describes the procedures to be followed to gain access to the major 67XXA assemblies and PCBs for troubleshooting or maintenance. All necessary diagrams are provided.

8 SPECIAL OPTIONS

Section VIII is reserved for a listing and description of any special options that are provided with your model 67XXA Swept Frequency Synthesizer.

Digitized by the Internet Archive
in 2024

https://archive.org/details/manualsplus_04082

SECTION I
GENERAL INFORMATION

CONTENTS

Paragraph	Title	Page
1-1	SCOPE OF THE MANUAL	1-3
1-2	INTRODUCTION	1-3
1-3	IDENTIFICATION NUMBER	1-3
1-4	RELATED MANUALS	1-3
1-5	DESCRIPTION	1-3
1-6	OPTIONS	1-3
1-7	PERFORMANCE SPECIFICATIONS	1-4
1-8	RECOMMENDED TEST EQUIPMENT	1-4

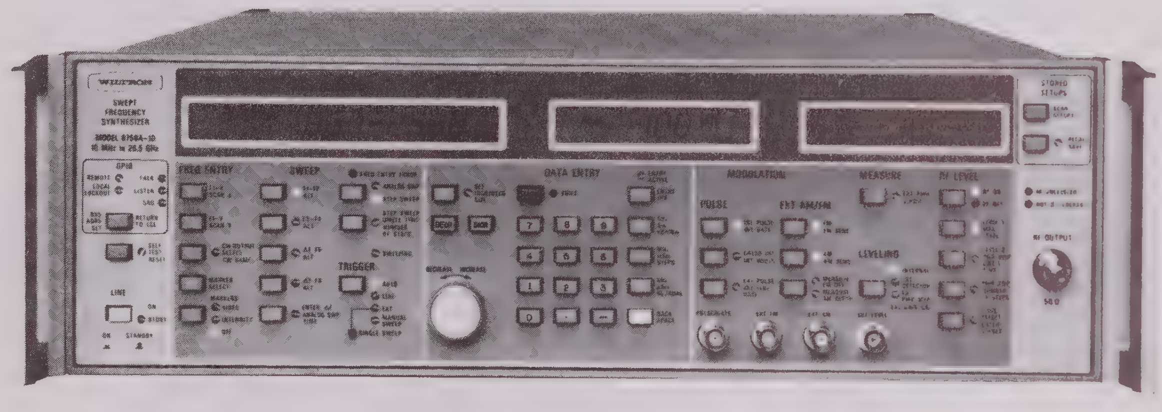

WILTRON
SWEPT FREQUENCY SYNTHESIZER
GPIB
LINE
FREQ ENTRY
SWEEP
TRIGGER
DATA ENTRY
MODULATION
PULSE
EXT AM/FM
MEASURE
LEVELING
RF LEVEL
STORED SETUPS
RF OUTPUT

Figure 1-1. Typical Series 67XXA Swept Frequency Synthesizer

SECTION I
GENERAL INFORMATION

1-1 SCOPE OF THE MANUAL

This manual provides general information, performance verification, calibration, parts, and service information for the model number indicated on the title page. Most of the information in this manual applies to all models in the 67XXA series; these pages are indicated by "67XXA" notation at the base of the page and in text. Specific model number references are made where the information presented is unique to that model only.

1-2 INTRODUCTION

Section I provides a general description of the equipment, its identification number, manuals, performance specifications, and options. A list of recommended test equipment is also given.

1-3 IDENTIFICATION NUMBER

All WILTRON instruments are assigned a unique six-digit ID number, such as "405001." Each 67XXA has two ID numbers assigned – one for the basic frame and one for the RF deck. The ID number for the RF deck is affixed to the outside of the rear panel, while that for the basic frame is affixed to chassis floor, below the swing-out RF deck. The RF deck ID number, on the outside, is the primary number. Please use it when ordering parts or corresponding with WILTRON's Customer Service department.

1-4 RELATED MANUALS

This is one of a two manual set that consists of an Operating Manual (OM) and a Maintenance Manual (MM). The OM provides coverage for all models in the 67XXA series. Conversely, the MMs contains model-dependent information. Because of this model dependency there are seventeen different MMs—one for each frequency model. The MMs provide performance verification, calibration, parts, and service (schematics, block diagrams, circuit description) information for the model being covered. Each frequency model may also be covered by a preliminary MM. If preliminary MMs exist, they will be discontinued when the final MM becomes available. The WILTRON part number for this manual is listed on the title page; the part numbers for all MMs and preliminary MMs are listed in Table 1-1.

Table 1-1. Maintenance Manual Part Numbers

67XX Model Number(s)	Final Manual Part Number	Preliminary Manual Part Number
6709A/–40	10370-00010	10370-00008
6717A/–20	10370-00014	10370-00012
6719A	10370-00018	10370-00016
6721A/–20	10370-00022	10370-00020
6722A/–20	10370-00082	10370-00080
6728A/–40	10370-00026	10370-00024
6729A/–20	10370-00034	10370-00032
6730A/–40	10370-00038	10370-00036
6736A	10370-00042	10370-00040
6737A/–20	10370-00046	10370-00044
6740A	10370-00076	10370-00078
6742A	10370-00050	10370-00048
6747A/–20	10370-00054	10370-00052
6753A/–10	10370-00058	10370-00056
6759A/–10	10370-00062	10370-00060
6763A	10370-00066	10370-00064
6769A	10370-00070	10370-00068

1-5 DESCRIPTION

The Series 67XXA Swept Frequency Synthesizers are microprocessor-based, GPIB, synthesized signal sources that generate swept and CW frequencies in one or more frequency bands between 10 MHz and 40 GHz. The series, which will expand as additional frequency ranges are added, presently consists of 28 models covering a variety of frequency and power ranges. Table 1-2 lists all models presently available, their frequency range, and their output power level.

1-6 OPTIONS

The following standard instrument options are available.

Option 1, Rack Mount. A kit is available containing mounting brackets and chassis track slides.

Table 1-2. 67XXA Series Swept Frequency Synthesizers

67XXA Model	Frequency (GHz)	Output Power
6709A	0.01 to 2	+10 dBm
6709A-40		+16 dBm
6717A	0.01 to 8.4	+10 dBm
6717A-20		+13 dBm
6719A	2 to 8.4	+13 dBm
6721A	2 to 12.4	+10 dBm
6721A-20		+13 dBm
6722A	0.01 to 12.4	+10 dBm
6722A-20		+13 dBm
6728A	8 to 12.4	+13 dBm
6728A-40		+16 dBm
6729A	8 to 20	+10 dBm
6729A-20		+13 dBm
6730A	12.4 to 20	+13 dBm
6730A-40		+16 dBm
6736A	18 to 26.5	+7 dBm
6737A	2 to 20	+10 dBm
6737A-20		+13 dBm
6740A	26.5 to 40	+10 dBm
6742A	18 to 40	+7 dBm
6747A	0.01 to 20	+10 dBm
6747A-20		+13 dBm
6753A	2 to 26.5	+10 dBm,≤20 GHz +5 dBm,>20 GHz
6753A-10		+10 dBm
6759A	0.01 to 26.5	+10 dBm,≤20 GHz +5 dBm,>20 GHz
6759A-10		+10 dBm
6763A	2 to 40	+10 dBm,≤20 GHz +5 dBm,>20 GHz
6769A	0.01 to 40	+10 dBm,≤20 GHz +5 dBm,>20 GHz

* Optional attenuator reduces rated power by 3 dB.

Option 2A, 110 dB Step Attenuator. Each synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available only for the following models:

6709A/6709A-40
6717A/6717A-20
6719A
6721A/6721A-20
6728A/6728A-40

Option 2B, 90 dB Step Attenuator. Each synthesizer comes supplied with a 90 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available for all models having an upper frequency limit above 18 GHz.

Option 2C, 110 dB Step Attenuator. Each synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available for all models having an upper frequency limit above 18 GHz.

Option 9K, K Connector. Each synthesizer comes supplied with a rear panel K Connector™ RF Output instead of the type of connector that would normally be installed on the front panel. The front panel connector is deleted. Rated output power, flatness, and SWR are slightly degraded.

1-7 PERFORMANCE SPECIFICATIONS

Performance specifications for all 67XXA series synthesizers are listed in Section 1 of the Operating Manual.

1-8 RECOMMENDED TEST EQUIPMENT

Table 1-3 provides a lists of recommended test equipment needed to check and service the 67XXA Series Swept Frequency Synthesizers. The entries are coded to show for which types of testing the equipment is used. These codes are described below.

Code	Type of Testing
C	Calibration/Adjustment (MM-Section 3)
P	Performance Verification (MM-Section 2)
T	Troubleshooting (MM-Section 6)

Table 1-3. Recommended Test Equipment Used for Performance Tests, Calibration/Adjustments and Troubleshooting

INSTRUMENT	CRITICAL SPECIFICATION	RECOMMENDED MANUFACTURER/MODEL	USED IN SECTION(S)
Spectrum Analyzer	*Frequency:* 0.01 to 40 GHz *Resolution:* 30 Hz	Tektronix, Model 494P Ext. Mixer PNs: WM 490K (18 - 26.5 GHz) WM 490A (26.5 - 40 GHz) Diplexer PN: 015-3085-00	P, C, T
Frequency Counter	*Frequency:* 0.01 to 40 GHz *Input Impedance:* 50Ω *Resolution:* 1 Hz *Other:* Ext Time Base Input	EIP Microwave, Inc. Model 578A, Option 91	P, C, T
Power Meter with Power Sensors	*Power Range:* –30 to +20 dBm	Hewlett-Packard, Model 436A	P, T
	Frequency Range: 0.01 to 20 GHz *Frequency Range:* 0.01 to 26.5 GHz *Frequency Range:* 26.5 to 40 GHz	Hewlett-Packard Model 8484A Hewlett-Packard Model 8485A Hewlett-Packard Model R8486A	
Digital Voltmeter	*Resolution:* 4-1/2 digits (to 20V) *DC Accuracy:* 0.002% + 2 counts *DC Input Impedance:* 10 MΩ *AC Accuracy:* 0.07% + 100 counts (to 20 kHz) *AC Input Impedance:* 1 MΩ	John Fluke, Inc. Model 8840A With Option 8840A-09 (True RMS AC)	P, C, T
Frequency Standard	*Frequency:* 10 MHz *Accuracy:* 1×10^{-10} parts/day	Spectracom Corp. Model 8161	P, C
Function Generator	*Output Voltage:* 300 mV to 10V *Functions:* 200 kHz sine wave, 100 Hz square wave	Hewlett-Packard Model 8116A	P, C
Oscilloscope	*Bandwidth:* dc to 150 MHz *Sensitivity:* 2 mV *Horiz. Sensitivity:* 50 ns/division	Tektronix, Inc. Model 2445	P, C, T
Microwave (Pulse) Detector	*Output Polarity:* Negative *Frequency Range:* dc to 40 GHz	Wiltron Company Model 75KA50	P, C
Modulation Analyzer	*Frequency Input:* 10 MHz (or the IF of the spectrum analyzer) *FM Max. Deviation:* 500 kHz *FM Accuracy:* ±1% to 100 kHz rate *AM Depth:* 0% to 90% *AM Mod. Rates:* dc to 100 kHz *AM Accuracy:* ± 3% *Filters:* 50 Hz lowpass, 15 kHz highpass	Hewlett-Packard Model 8901A	P, C
Scalar Network Analyzer	*Frequency Range:* 0.01 to 40 GHz	WILTRON Model 562, with 560-7N50 RF Detector 560-7K50 RF Detector	P, C
High Pass Filter	150 MHz High-Pass Filter (DC Block)	Narda, Model 4564	P
Low Pass Filter	450 MHz Low Pass Filter	Mini-Circuits, Model LP-450	P
Tee	*Connectors:* 50Ω BNC	Any common source	P, C
Cables	*Connectors:* 50Ω BNC	Any common source	P, C, T

NOTES: 1) P = Performance Tests (Section 2); C = Calibration/Adjustments (Section 3); T = Troubleshooting (Section 6)

2) This table does not include the recommended test equipment that is necessary to perform the automated RF Level Calibration Test; refer to section 3, Calibration/Adjustments.

3) Please contact WILTRON Customer Service at (408) 778-2000 for help regarding test equipment compatibility.

SECTION II
PERFORMANCE VERIFICATION

CONTENTS

Paragraph	Description	Page
2-1	INTRODUCTION	2-3
2-2	RECOMMENDED TEST EQUIPMENT	2-3
2-3	PERFORMANCE VERIFICATION TEST RECORD	2-3
2-4	CONNECTOR AND KEY LABEL NOTATION	2-3
2-5	INTERNAL TIME BASE AGING RATE TEST	2-5
2-6	FREQUENCY SYNTHESIS TESTS	2-7
2-7	MARKER AND BLANKING VERIFICATION	2-9
2-8	NARROW BAND SPURIOUS TESTS	2-11
2-9	SPURIOUS AND HARMONIC TESTS: RF OUTPUT SIGNALS ≤2 GHz	2-12
2-10	HARMONIC TEST: RF OUTPUT SIGNALS FROM 2 TO 10 GHz	2-14
2-11	HARMONIC TEST: RF OUTPUT SIGNALS FROM 11 TO 20 GHz	2-15
2-12	HARMONIC TEST (ALTERNATE METHOD): RF OUTPUT SIGNALS FROM 10 TO 30 GHz	2-17
2-13	HARMONIC TEST: RF OUTPUT SIGNALS FROM 26.5 TO 40 GHz	2-19
2-14	POWER LEVEL ACCURACY AND FLATNESS VERIFICATION	2-20
2-15	FM MODULATION TEST	2-22
2-16	AM MODULATION TEST	2-25
2-17	PULSE MODULATION TEST: RISE TIME, FALL TIME, OVERSHOOT, AND LEVEL	2-28
2-18	PULSE MODULATION TEST: VIDEO FEEDTHROUGH	2-31
2-19	PULSE MODULATION TEST: RF ON/OFF RATIO	2-32

SECTION II
PERFORMANCE VERIFICATION

2-1 INTRODUCTION

This section contains procedures used to verify the performance of 67XXA Swept Frequency Synthesizers to specifications. These procedures cover all units having any version of firmware. Instruments with Option 2 (90 or 110 dB) step attenuators are also supported.

NOTE

For brevity, the standard and high power versions of a particular 67XXA model are referred to jointly throughout these procedures. For example, the term "6747A/-20" is used to refer to either the 6747A (+10 dBm RF output) or the 6747A-20 (+13 dBm RF output). Reference is made to a specific version of the instrument model only when the procedure for that model type requires special instructions.

The generic "67XXA" reference refers to any synthesizer model; model number is not critical in such a case.

2-2 RECOMMENDED TEST EQUIPMENT

Table 2-1 on the following page lists the test equipment required for the performance tests.

The procedures refer to specific test equipment front panel control labels when the setup parameters of the test are critical to making an accurate measurement. In some cases, the user may substitute equipment having the same critical specifications as those of the recommended test equipment listed in Table 2-1.

Contact the WILTRON Customer Service department at (408) 778-2000 if you need clarification of any equipment or procedural reference.

2-3 PERFORMANCE VERIFICATION TEST RECORD

A blank copy of a sample performance verification test record is provided in Section 4, Test Records. The test record contains the model-specific variables called for by the procedures in this section and provides the means for maintaining an accurate and complete record of instrument performance. We recommend that you copy these pages and record on them the results from your initial testing of the instrument. These initial test results can later be used as benchmark values for future tests of the same instrument (referenced by its rear panel instrument serial number).

2-4 CONNECTOR AND KEY LABEL NOTATION

The test instructions include many references to equipment interconnections and control settings. For all 67XXA references, specific labels are used to denote the appropriate control key or connector (such as CW OUTPUT SELECT or RF OUTPUT). Most references to supporting test equipment use general labels for commonly used controls and connections (such as Span or RF Input). In some cases, a specific label is used that is a particular feature of the test equipment listed in Table 2-1.

Many of the 67XXA front panel control keys, when pressed, cause an LED indicator next to the key to light verifying the selection. Observe the lighting of the LED indicator to ensure that the desired function is enabled.

During the test sequence, three LED indicators that should be monitored continuously are the ENTRY ACTIVE, RF UNLEVELED, and NOT Ø-LOCKED indicators. The lighting of the ENTRY ACTIVE LED indicates that the Data Entry function is active. The lighting of the RF UNLEVELED LED or NOT Ø-LOCKED LED in step sweep or CW mode may signal a situation that is the result of an instrument failure and may cause errant test results.

Table 2-1. Recommended Test Equipment Used in the Performance Tests

INSTRUMENT	CRITICAL SPECIFICATION	RECOMMENDED MANUFACTURER/MODEL	REQUIRED FOR TEST(S)
Spectrum Analyzer with Diplexer and External Mixers	*Frequency:* 0.01 to 40 GHz *Resolution:* 30 Hz	Tektronix, Model 494P Ext. Mixer PNs: WM 490K (18 - 26.5 GHz) WM 490A (26.5 - 40 GHz) Diplexer PN: 015-3085-00	2-8, 2-9, 2-10, 2-11,2-13, 2-15,2-16, 2-19
Frequency Counter	*Frequency:* 0.01 to 40 GHz *Input Impedance:* 50Ω *Resolution:* 1 Hz *Other:* Ext Time Base Input	EIP Microwave, Inc. Model 578A, Option 91	2-6
Power Meter with Power Sensors	*Power Range:* –30 to +20 dBm *Frequency Range:* 0.01 to 20 GHz *Frequency Range:* 0.01 to 26.5 GHz *Frequency Range:* 26.5 to 40 GHz	Hewlett-Packard, Model 436A Hewlett-Packard Model 8484A Hewlett-Packard Model 8485A Hewlett-Packard Model R8486A	2-14, 2-17
Digital Voltmeter	*Resolution:* 4-1/2 digits (to 20V) *DC Accuracy:* 0.002% + 2 counts *DC Input Impedance:* 10 MΩ *AC Accuracy:* 0.07% + 100 counts (to 20 kHz) *AC Input Impedance:* 1 MΩ	John Fluke, Inc. Model 8840A With Option 8840A-09 (True RMS AC)	2-15, 2-16
Frequency Standard	*Frequency:* 10 MHz *Accuracy:* 1 x 10^{-10} parts/day	Spectracom Corp. Model 8161	2-5
Function Generator	*Output Voltage:* 300 mV to 10V *Functions:* 200 kHz sine wave, 100 Hz square wave	Hewlett-Packard Model 8116A	2-15, 2-16
Oscilloscope	*Bandwidth:* dc to 150 MHz *Sensitivity:* 2 mV *Horiz. Sensitivity:* 50 ns/division	Tektronix, Inc. Model 2445	2-5, 2-7,2-14, 2-17, 2-18
Mictrowave (Pulse) Detector	*Output Polarity:* Negative *Frequency Range:* dc to 40 GHz	Wiltron Model 75KC50	2-17
Modulation Analyzer	*Frequency Input:* 10 MHz (or the IF of the spectrum analyzer) *FM Max. Deviation:* 500 kHz *FM Accuracy:* ±1% to 100 kHz rate *AM Depth:* 0% to 90% *AM Mod. Rates:* dc to 100 kHz *AM Accuracy:* ± 3% *Filters:* 50 Hz lowpass, 15 kHz highpass	Hewlett-Packard Model 8901A	2-16
Scalar Network Analyzer	*Frequency Range:* 0.01 to 40 GHz	Wiltron Model 562, with 560-7N50 RF Detector 560-7K50 RF Detector	2-12
High Pass Filter	150 MHz High-Pass Filter	Narda, Model 4564	2-17
Low Pass Filter	450 MHz Low Pass Filter	Mini-Circuits, Model LP-450	2-18
Tee	*Connectors:* 50Ω BNC	Any common source	2-15, 2-16
Cables	*Connectors:* 50Ω BNC	Any common source	All tests

2-5 INTERNAL TIME BASE AGING RATE TEST

a. Test Description

The following procedure verifies that the 67XXA 10 MHz time base is within its aging specification. The 67XXA derives its frequency accuracy from an internal 10 MHz crystal oscillator standard. An inherent characteristic of crystal oscillators is the effect of crystal "aging" within the first few days to weeks of operation. Typically, a crystal oscillator's frequency increases slightly at first, then settles to a relatively constant value for the rest of its life. The 67XXA reference oscillator aging is specified as $1\mathrm{x}10^{-9}$ parts per day (24 hour period).

NOTE

> Do not confuse crystal aging with other short-term frequency instabilities like noise and temperature.

For greatest absolute frequency accuracy, allow the 67XXA to warm up until its RF output frequency has stabilized (usually 7 to 30 days) before adjustment (calibration). After calibration, the change in reference oscillator frequency should remain within the aging rate if: (1) the time base oven is not allowed to cool, (2) the instrument orientation with respect to the earth's magnetic field is maintained, and (3) the instrument does not sustain any mechanical shock. This test should be done upon receipt of the instrument and again after a period of several days to weeks to fully qualify the aging rate.

The time (in seconds) required for a specific phase change of 1 cycle (360°) is measured at the start and finish of the test time period (at least 3 but preferably 24 hours or more). Aging rate is calculated with a formula that (inversely) relates time and frequency.

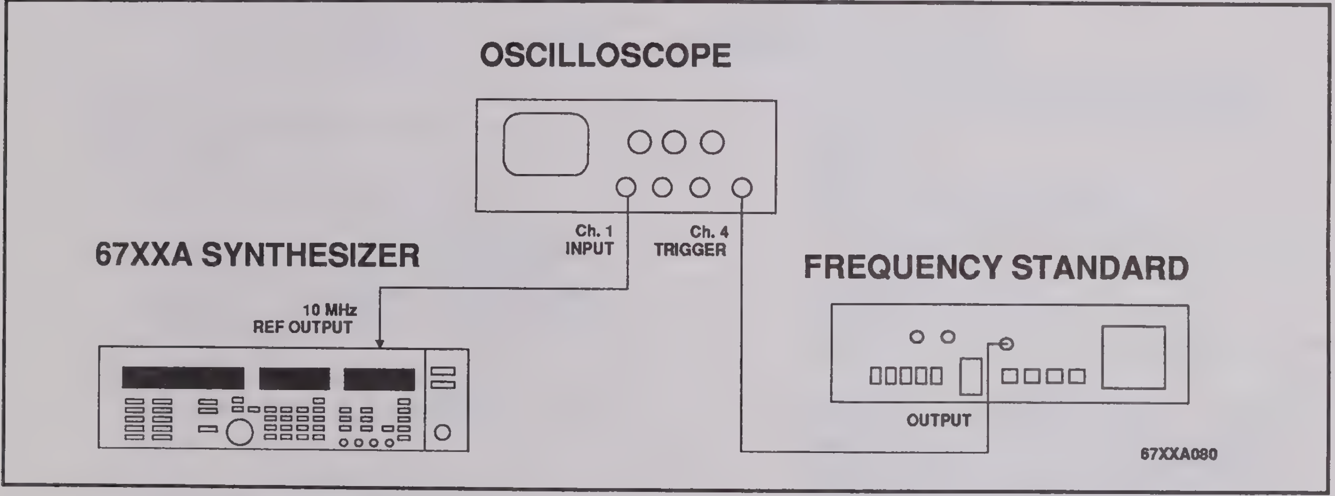


Figure 2-1. Equipment Setup for Internal Time Base Aging Rate Test

b. Test Setup

1. Connect the equipment as shown in Figure 2-1.
   (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Oscilloscope vertical input.
   (b) Connect the Frequency Standard (having long term stability $\leq 1 \mathrm{X} 10^{-10}$) to the Oscilloscope external trigger input.
   (c) Set the Oscilloscope controls as follows:
      (1) TIME/DIV: 50 ns
      (2) VOLT/DIV: 0.5

c. Test Procedure

1. Adjust the Oscilloscope external triggering controls for a stable display of the 67XXA 10 MHz REF OUTPUT signal.
2. Record the start time of the test period as T_S in the Test Record.
3. Immediately, measure the time (in seconds) required for a 360 degree phase change on the Oscilloscope display. Record this as T_1 in the Test Record.
4. Wait for a period of time (at least 3 but preferably 24 hours) and remeasure the time required for a 360 degree phase change. Record this as T_2 in the Test Record.

5. Immediately, record the finish time of the test period as T_F in the Test Record.

6. Calculate the aging rate as follows:

$$\text{Aging Rate} = \left(\frac{1\,\text{cycle}}{F_{STD}}\right) \times \left(\left|\frac{1}{T_1} - \frac{1}{T_2}\right|\right) \times \left(\frac{T_{SPEC}}{T_F - T_S}\right)$$

Where:
F_{STD}=10x10^6 Hertz
(67XXA ref. oscillator frequency)
T_F=Test period end time (hours)
T_S=Test period start time (hours)
T_1=Initial 360° phase change time (seconds)
T_2=Final 360° phase change time (seconds)
T_{SPEC}=Spec. reference period (i.e., per day)
1 cycle=Phase change reference for the time measurement (in this case 360 degrees)

7. Record the computed result in the Test Record. To meet the specification, the calculated aging rate must be $<1\text{x}10^{-9}$ per day.

2-6 FREQUENCY SYNTHESIS TESTS

a. Test Description

The frequency synthesis tests are divided into two main parts, fine loop tests and coarse loop/YIG loop tests. The coarse loop/YIG loop test steps the synthesizer through its full frequency range in 1 GHz steps. The fine loop tests steps the instrument through 1 kHz steps. Ten 1 kHz steps are needed to verify the fine loop.

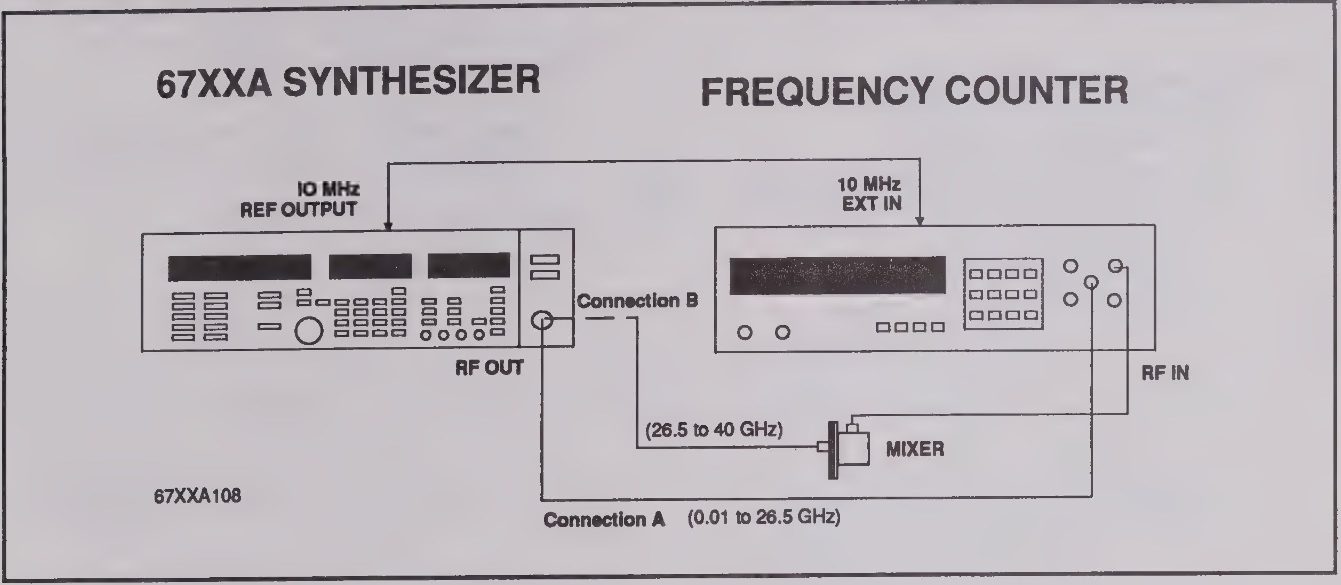


Figure 2-2. Equipment Setup for Frequency Synthesis Tests

b. Test Setup

1. Connect the equipment as shown in Figure 2-2.
   (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Frequency Counter 10 MHz External Reference input(If the Frequency Counter has an INT/EXT toggle switch, ensure switch is set to EXT).
   (b) Connect the 67XXA RF OUTPUT to the Frequency Counter RF Input.

NOTE

For measuring frequencies in the range of 0.01 to 26.5 GHz connect the 67XXA RF OUT to the Frequency Counter RF IN as shown in Connection A. For measuring frequencies in the range of 26.5 to 40 GHz connect the 67XXA RF OUT to the Frequency Counter RF IN as shown in Connection B using the Option 91 waveguide mixer.

c. Coarse Loop/YIG Loop Test Procedure

1. Initialize the 67XXA for 1 GHz steps as follows:
   (a) Press <Shift> RESET.
   (b) Press CW OUTPUT SELECT.
   (c) Enter the frequency indicated on the Test Record.
   (d) Press SET INCR/DECR SIZE.
   (e) Enter 1 GHz (0.5 GHz for model 6709A).

2. Record the Frequency Counter reading on the Test Record. The Frequency Counter reading must be within ±100 Hz of the displayed 67XXA frequency (±200 Hz for frequencies above 26.5 GHz) to accurately complete this test.

NOTE

The counter is typically within ±1 Hz since the instruments use a common time base. Differences of a few Hertz can be caused by noise and counter limitations. Differences of ≥±100 Hz (±200 Hz above 26.5 GHz)indicate a frequency synthesis problem.

3. On the 67XXA, press INCR. Record the Frequency Counter reading in the Test Record.

4. Repeat step c.3 until all frequencies listed in the Test Record have been recorded.

d. Fine Loop Test Procedure

1. Set the 67XXA for 1 kHz steps as follows:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT.
   - (c) Enter the frequency indicated on the Test Record.
   - (d) Press SET INCR/DECR SIZE.
   - (e) Enter 1 kHz.

2. Record the Frequency Counter reading in the Test Record. It must be within ±100 Hz of the 67XXA displayed frequency to meet specification.

3. On the 67XXA, press INCR. Record the Frequency Counter reading in the Test Record.

4. Repeat step d.3 until all frequencies listed in the Test Record have been recorded.

2-7 MARKER AND BLANKING VERIFICATION

a. Test Description

This test verifies correct operation of the markers and blanking signals. Operation and programmability are both tested.

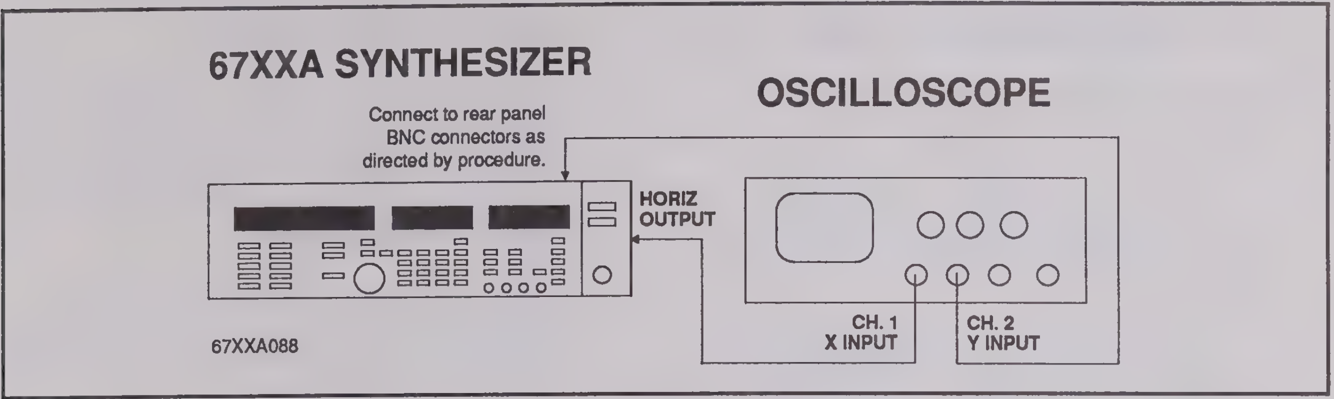


Figure 2-3. Equipment Setup for Marker and Blanking Verification

b. Test Setup

1. Connect the equipment as shown in Figure 2-3.
   (a) Connect the 67XXA rear panel MARKER OUTPUT to the Oscilloscope Ch. 2 input (Y-axis input).
   (b) Connect the 67XXA rear panel HORIZ OUTPUT to the Oscilloscope Ch. 1 input (X-axis input).

2. Set up the Oscilloscope as follows:
   (a) X input – DC Input Impedance
   (b) Y input – Vertical Input to 2V/div
   (c) Set Horiz to Ext Triggering
   (d) If desired, turn CH. 1 off to elimiate unnecessary viewing of the 6700 ramp.
   (e) Adjust X-axis input to center presentation.

c. Marker Selection Procedure

1. Set up the 67XXA for a full-range sweep:
   (a) Press <Shift> RESET.
   (b) Press F1-F2.
   (c) Press <Shift> TRIGGER 0 8 0 to unlock the 67XXA; this permits easier viewing of the markers on the Oscilloscope display.

2. Press F1-F9 SCAN Δ to display the F1 frequency noted on the Test Record. Press the 67XXA MARKER SELECT button, then press MARKERS VIDEO. Verify that a marker appears on the Oscilloscope. Note its presence on the Test Record.

3. Check the other eight markers as follows:
   (a) Press F1-F9 SCAN Δ to display the F2 frequency noted on the Test Record.
   (b) Press MARKER SELECT to select the next marker. Verify that a marker appears on the Oscilloscope. Note its presence on the Test Record.

4. Repeat step 3 until all nine markers have been selected and verified. Note their presence on the Test Record.

d. *Marker Output Verification Procedure*

1. Observe the oscilloscope display and verify that +5V (TTL high) marker signals appear at nine points along the horizontal axis. (All markers have already been selected in the previous Marker Selection procedure.) Note their presence on the Test Record.

2. On the 67XXA, select MARKERS INTENSITY.

3. Verify that each marker changes from a +5V (TTL high) signal to to an intensified spot. Note the presence of each on the Test Record.

4. Move the Oscilloscope Y-axis input from the 67XXA rear panel MARKER OUTPUT to the 67XXA rear panel SEQ SYNC OUTPUT.

5. On the 67XXA, select MARKERS VIDEO and verify that the waveform changes:
   (a) To a +5V signal (TTL high) at retrace;
   (b) To a +5V signal at each bandswitch point;

   NOTE
   Bandswitching is not applicable to models 6709A/-40, 6719A, 6728A/-40, 6730A/-40, 6736A, and 6740A.

   (c) To a +5V signal at each switched-filter switch point;

   NOTE
   Switched-filter switching is not applicable to models 6709A/-40, 6728A/-40, 6729A/-20, 6730A/-40, 6736A, 6740A, and 6742A.,

   (d) To −10V at the selected (active) video marker frequency;
   (e) To −5V at all other marker frequencies.
   (f) Note the result of steps d.5(a), d.5(b), d.5(c), d.5(d), and d.5.(e) on the Test Record.

6. Press the F1-F9 SCAN Δ key to select another marker. Verify that the newly selected marker changes from −5V to −10V signal, and that the previously selected marker changes to −5V signal. Note the result on the Test Record.

e. *Retrace Blanking Output Verification Procedure*

1. Move the Oscilloscope Y-axis input from the 67XXA rear panel SEQ SYNC OUTPUT connector to the 67XXA rear panel RETRACE BLANK OUTPUT connector.

2. With the 67XXA rear panel FUNCTION SELECT set for −BLANK, verify that the signal changes to −5V during retrace. Note the result on the Test Record.

3. With the 67XXA rear panel FUNCTION SELECT set to +BLANK, verify that the signal changes to +5V during retrace. Note the result on the Test Record.

f. *Bandswitch Blanking Output Verification Procedure*

(Not applicable to models 6709A/-40, 6719A, 6728A/-40, 6730A/-40, 6736A, and 6740A)

1. Move the Oscilloscope Y-axis input from the 67XXA rear panel RETRACE BLANK OUTPUT to the 67XXA rear panel BANDSWITCH BLANK OUTPUT connector.

2. With the 67XXA rear panel FUNCTION SELECT set to +BLANK, verify that the signal only changes to +5V during the bandswitch dwell points listed on the Test Record. Note the result on the Test Record.

3. With the 67XXA rear panel FUNCTION SELECT set to −BLANK, verify that the signal only changes to −5V during the bandswitch dwell points listed on the Test Record. Note the result on the Test Record.

g. *67XXA Relock Procedure*

1. Press <SHIFT> TRIGGER 0 8 1 to relock the 67XXA.

2-8 NARROW BAND SPURIOUS TESTS

a. Test Description

This test verifies that the fine and coarse loop fractional division filters are functioning properly.

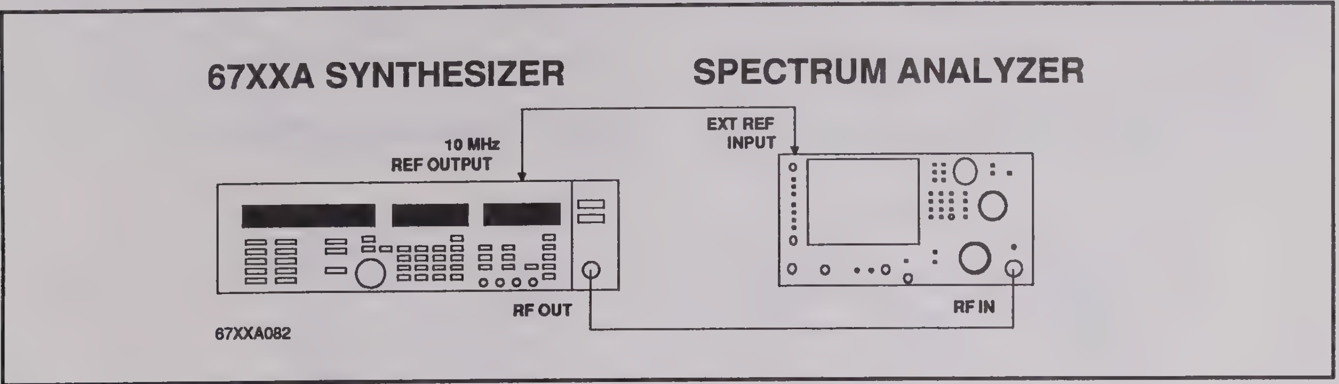


Figure 2-4. Equipment Setup for Narrow Band Spurious Tests

b. Test Setup

1. Connect the equipment as shown in Figure 2-4.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

c. Fine Loop Test Procedure

1. Set up the 67XXA for fractional division on the fine loop as follows:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT and enter the frequency indicated on the Test Record.
   - (c) Press SET INCR/DECR SIZE.
   - (d) Enter 1 kHz.
   - (e) Press INCR.

2. Set up the Spectrum Analyzer as follows:
   - (a) CF: Set to 10 kHz higher than 67XXA frequency value.
   - (b) RF Level: Set signal peak to top graticule.
   - (c) Span: Set to 100 Hz
   - (d) RBW: 10 Hz
   - (e) Video Filter: On (if necessary)

NOTE

In order to make an accurate measurement of the 67XXA spurious responses, the noise floor of the Spectrum Analyzer must be clearly below –65 dBc, preferably below –75 dBc.

3. Measure and record on the Test Record, any spurious signals at 10, 20, 30, 40, and 50 kHz away from the carrier. (On the Spectrum Analyzer, increase the center frequency by 10 kHz for each measurement to keep any measured peak at center screen.)

d. Coarse Loop Test Procedure

1. Set up the 67XXA for fractional division on the coarse loop as follows:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT and enter the frequency indicated on the Test Record.
   - (c) Press SET INCR/DECR SIZE.
   - (d) Enter 2 MHz.
   - (e) Press INCR.

2. Set up the Spectrum Analzer as follows:
   - (a) Span: 100 kHz/div
   - (b) CF: Set to 200 kHz higher than the 67XXA frequency value.
   - (c) RBW: 1 kHz
   - (d) Wide Video Filter: On

3. Measure and record on the Test Record, any spurious signals at 200 and 400 kHz away from the carrier. (On the spectrum analyzer, increase the center frequency by 200 kHz for each measurement to keep any measured peak at center screen.)

2-9 SPURIOUS AND HARMONIC TESTS: RF OUTPUT SIGNALS ≤2 GHz

a. Test Description

This test is applicable to the following 67XXA models only: 6709A/-40, 6717A/-20, 6722A/-20, 6747A/-20, 6759A/-10, and 6769A. This test verifies that the 67XXA synthesizer meets its 0.01–2 GHz harmonic specifications.

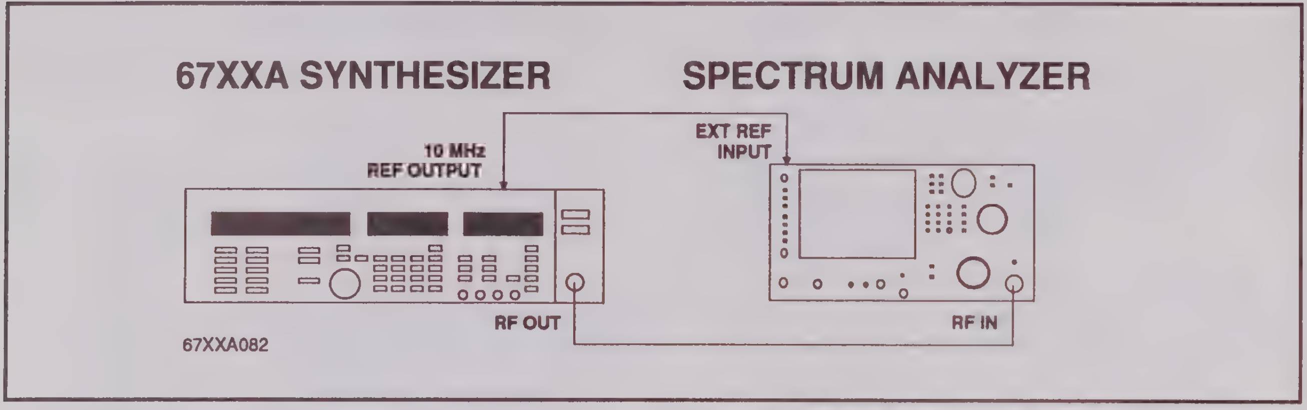


Figure 2-5. Equipment Setup for Spurious and Harmonic Tests: RF Output Signals ≤2 GHz

b. Test Setup

1. Connect the equipment as shown in Figure 2-5.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

c. Test Procedure

1. Set up the Spectrum Analyzer as follows:
   - (a) Span: 10 MHz/div
   - (b) CF: 50 MHz
   - (c) RBW: 1 MHz
   - (d) Sweep Time/Div: Auto (to resolve signal peaks clearly)

2. Set the the 67XXA as follows:
   - (a) Press <Shift> RESET
   - (b) Press CW OUTPUT SELECT
   - (c) Enter 10 MHz.

3. On the Spectrum Analyzer, measure and record on the Test Record the presence of the worst case harmonic of the 10 MHz carrier that is ≤–30 dBc (≤—20 dBc for the 6709A-40, 6717A-20, 6722A-20, and 6747A-20 models) and the worst case spurious response that is ≤–40 dBc.

NOTE

Harmonics appear at multiples of the CW frequency and diminish quickly as the CW frequency goes greater than 1 GHz.

4. Repeat steps c.2(b), c.2(c), and c.3 for 67XXA CW frequencies of 20 and 30 MHz. Measure and record the presence of the worst case harmonics and spurious responses.

5. Change the Spectrum Analyzer as follows:
   - (a) Span: 100 MHz/div
   - (b) CF: 500 MHz

6. Repeat steps c.2(b), c.2(c), and c.3 for 67XXA CW frequencies of 40 MHz. Measure and record the presence of the worst case harmonic and spurious response.

7. Change the Spectrum Analyzer as follows:
   - (a) Span: 200 MHz/div (or maximum span width)
   - (b) CF: 1 GHz (N/A if at maximum span width)

8. Repeat steps c.2(b), c.2(c), and c.3 for a 67XXA CW frequency of 350 MHz. Measure and record the presence of worst case harmonic and spurious response.

9. Change the 67XXA CW frequency to 1.6 GHz. Measure and record the presence of the worst case spurious response.

10. Change the Spectrum Analyzer as follows:
    (a) Span: 10 MHz/div
    (b) CF: 1.6 GHz
    (c) RBW: 1 MHz

11. Adjust the Spectrum Analyzer Reference Level control to place the signal at the top of the screen graticule.

12. Change the Spectrum Analyzer CF to 3.2 GHz and then to 4.8 GHz. Compare the harmonic levels with the levels at 1.6 GHz. Measure and record the 3.2 GHz and the 4.8 GHz harmonic levels on the Test Record.

2-10 HARMONIC TEST: RF OUTPUT SIGNALS FROM 2 TO 10 GHz

a. Test Description

This test applies to all 67XXA models except: 6709A/-40, 6730A/-40, 6736A, 6740A, and 6742A. This test verifies that the 67XXA meets its harmonic specifications for RF Output signals from 2-10 GHz. Test Record entries are supplied for harmonics up to a frequency limit of 20 GHz. Additional harmonic checks may be made at any frequency of interest up to the RF output frequency limit of the 67XXA model being tested and through the use of waveguide mixers to extend the frequency range of the Spectrum Analyzer.

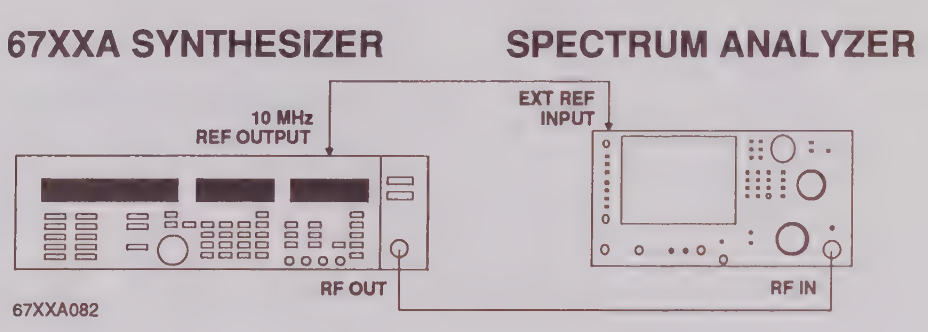


Figure 2-6. Equipment Setup for Harmonic Test: RF Output Signals From 2 to 10 GHz

b. Test Setup

1. Connect equipment as shown in Figure 2-6.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

c. Test Procedure

1. Set the 67XXA CW frequency as follows:
   - (a) Press <Shift> RESET
   - (b) Press CW OUTPUT SELECT
   - (c) Enter the frequency indicated on the Test Record

2. Set up the Spectrum Analyzer as follows:
   - (a) Span: 5 kHz/div
   - (b) CF: Set to the 67XXA frequency value
   - (c) RBW: 1 kHz
   - (d) Wide Video Filter: On

3. Adjust the Spectrum Analyzer Peaking control for maximum signal level, then adjust the Reference Level control to place the signal at the top of the screen graticule.

4. Change the Spectrum Analyzer CF to the harmonic frequencies listed on the Test Record and record the harmonic levels. To meet specifications, all harmonics must be ≥60 dBc.

5. Repeat steps 1 through 4 for the Test Record 67XXA CW carrier frequencies and harmonic frequencies. Record the results on the Test Record.

2-11 HARMONIC TEST: RF OUTPUT FROM 11 TO 20 GHz

a. Test Description

This test applies only to the following 67XXA models: 6742A, 6753A/-10, 6759A/-10, 6763A, and 6769A. This test verifies that the 67XXA meets its harmonic specifications for RF Output signals from 11 to 20 GHz. In order to perform the following procedures, the 67XXA RF output must cover the harmonic frequency of the carrier frequency being tested; i.e., if the 67XXA RF output maximum frequency is 26.5 GHz, then the maximum carrier frequency that can be tested for harmonics is 13.25 GHz.

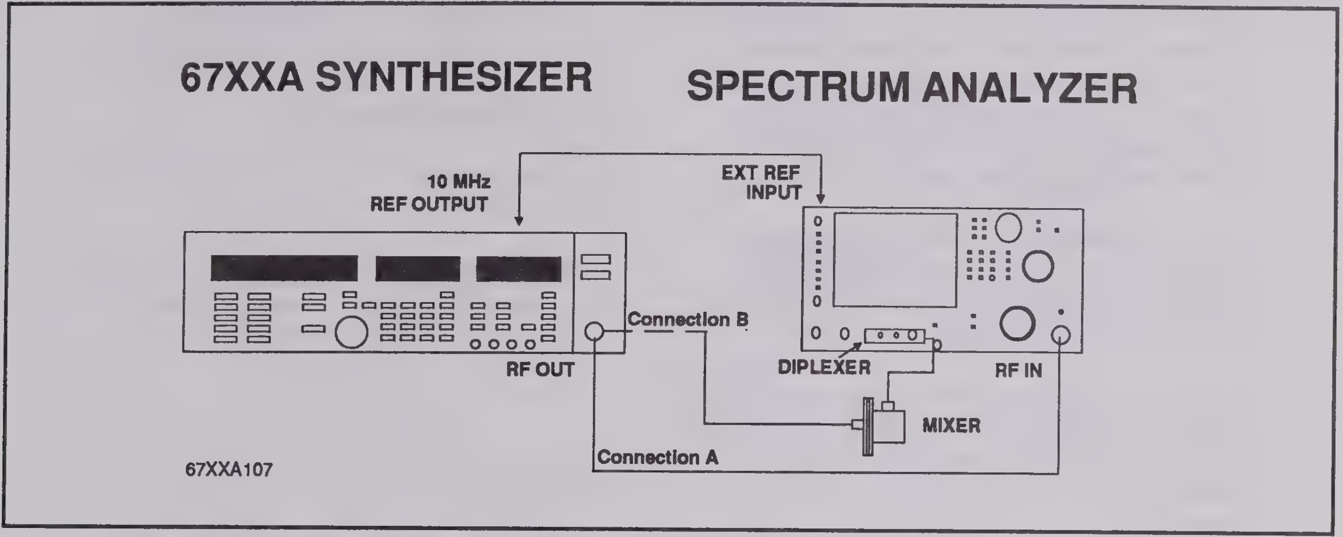


Figure 2-7. Equipment Setup for Harmonic Test: RF Output Signals From 11 to 20 GHz

b. Test Setup

1. Connect equipment as shown in Figure 2-7.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the diplexer and appropriate external waveguide mixer to the Spectrum Analyzer.
   - (c) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer as shown in Connection A (67XXA RF OUT to Spectrum Analyzer RF IN).

c. Test Procedure

NOTE

Since the external mixer is required for these measurements, the RF output flatness of the 67XXA instrument is used to correct for: (1) variations caused by switching from the fundamental input to the external mixer input of the spectrum analyzer, and (2) the flatness of the mixer.

1. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT.
   - (c) Enter the frequency indicated on the Test Record.
   - (d) Set the output power to –30 dBm.

NOTE

If the 67XXA is not fitted with Option 2, install a 30 dB attenuator (Wiltron 43KC-20 and 43 KC-10) and set the 67XXA output power to O dBm.

2. Set up the Spectrum Analyzer as follows:
   (a) CF: Same as the 67XXA frequency noted in step c.1.(c).
   (b) Span/Div: 5 kHz/div
   (c) RBW: 1 kHz
   (d) Wide Video Filter: On

3. Adjust the Spectrum Analyzer Peaking control for maximum signal, then adjust the Reference Level control to place the signal at the top of the screen graticule. It may be necessary to also adjust the 67XXA output power slightly to accomplish this: however, *do not exceed –20 dBm output power.*

4. Remove Connection A and connect the 67XXA RF OUTPUT to the Spectrum Analyzer as shown in Connection B (67XXA RF OUT to the waveguide mixer input).

5. On the 67XXA, remove 30 dB of attenuation from the RF output. Do this by either increasing the output power 30 dB or by removing the 30 dB attenuator installed in step c.1.(d).

6. Change the Spectrum Analyzer CF to the harmonic frequency listed on the Test Record and verify that the signal displayed on the Spectrum Analyzer is ≥30 dB below the top of the screen graticule.

NOTE

–30 dB plus the 30 dB attenuation provided by the waveguide mixer equals a harmonic frequency level of –60 dBc (specification).

7. Record the harmonic level on the Test Record.

8. Repeat steps 1 through 7 for the Test Record 67XXA CW carrier frequencies and harmonic frequencies.

2-12 HARMONIC TEST (ALTERNATE METHOD): RF OUTPUT FROM 10 TO 30 GHz

a. Test Description

This test applies to all 67XXA models except: 6709A/-40, 6717A/-20, and 6719A. This test describes an alternate method of verifying that the 67XXA meets its harmonic specifications for RF Output signals from 10 to 30 GHz. The test uses the high-pass characteristics of waveguide to block the 67XXA fundamental frequencies and pass only their harmonics to a crystal detector.

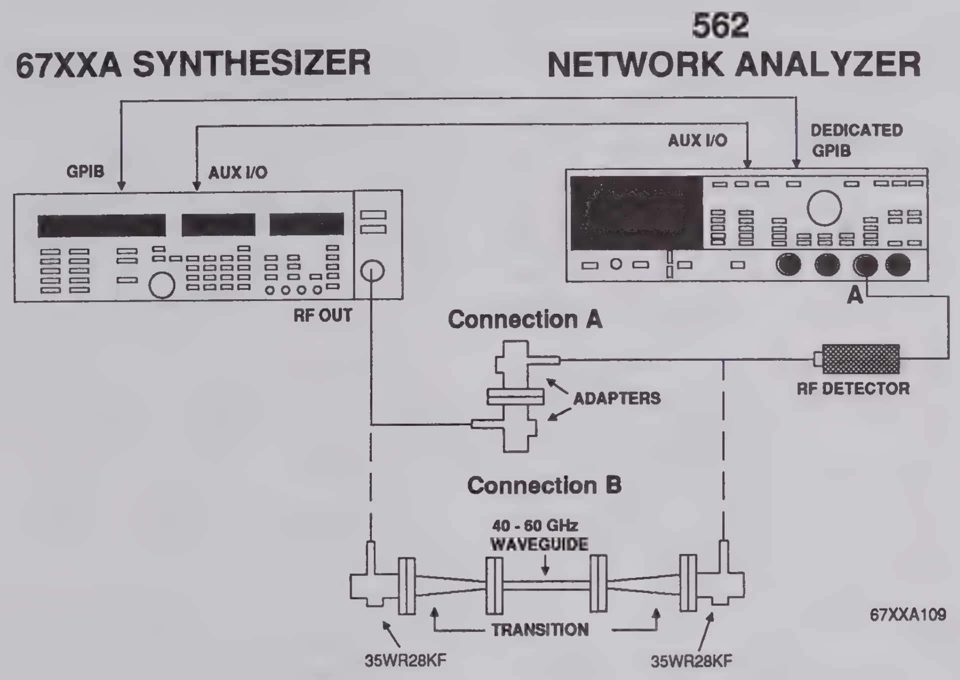

67XXA SYNTHESIZER
562
NETWORK ANALYZER
GPIB
AUX I/O
AUX I/O
DEDICATED
GPIB
RF OUT
A
Connection A
ADAPTERS
RF DETECTOR
Connection B
40 - 60 GHz
WAVEGUIDE
TRANSITION
35WR28KF
35WR28KF
67XXA109

Figure 2-8. Equipment Setup for Harmonic Test: RF Output Signals From 10 to 30 GHz

The following waveguide bands can be used for checking the harmonics of the fundamental frequencies listed.

Waveguide Band	Fundamental Frequency Range
18 - 26.5 GHz	7 - 14 GHz
18 - 40 GHz	8 - 20 GHz
26.5 - 40 GHz	11 - 20 GHz
40 - 60 GHz	16 - 30 GHz

The following Waveguide-to-Coaxial Adapters are used to produce the Waveguide Band filters used in this test procedure.

Waveguide-to-Coxial Adapters		
18 - 40 GHz	26.5 - 40 GHz	18 - 26.5 GHz
35WRD180KF	35WR28KF	35WR42KF
35WR180K	35WR28K	35WR42K

b. Test Setup

1. Connect the equipment as shown in Figure 2-8.
    - (a) Connect the 67XXA rear panel AUX I/O to the 562 Network Analyzer AUX I/O.
    - (b) Connect the 562 Network Analyzer DEDICATED GPIB to the 67XXA rear panel GPIB.
    - (c) Connect the RF Detector (Wiltron 560-7K50) to the 562 Network Analyzer Channel A Input.
    - (d) Connect the 67XXA RF OUTPUT to the RF Detector Input as follows:
        - (1) *(To test harmonics of 67XXA fundamental frequencies between 7 and 20 GHz)* Select the appropriate Waveguide-to-Coaxial Adapters for the fundamental frequency band being tested for harmonics and connect as shown in Connection A of Figure 2-8.
        - (2) *(To test harmonics of 67XXA fundamental frequencies between 16 and 30 GHz)* Referring to Connection B of Figure 2-8, connect the Adapters and Waveguide components shown between the 67XXA RF OUTPUT and the RF Detector Input.

c. Test Procedure

1. Set up the 562 Network Analyzer as follows:
    - (a) Press the SYSTEM MENU key.
    - (b) From the System Menu display, select RESET. This resets both the 562 and the 67XXA.
    - (c) Press CHANNEL 2 DISPLAY: OFF
    - (d) Press CHANNEL 1 DISPLAY: ON
    - (e) Press CHANNEL 1 MENU key.
    - (f) From the Channel 1 Menu display, select POWER.

2. Set up the 67XXA as follows:
    - (a) Press <Shift> RESET.
    - (b) Press F1-F9 SCAN▲ to display the F1 frequency.
    - (c) Enter the frequency indicated on the Test Record.
    - (d) Press F1-F2 SWEEP.

3. Observe the 562 Network Analyzer display. At frequencies below cutoff, the RF power displayed is caused by harmonics. At frequencies above cutoff, the displayed signal is the total RF power – fundamental and harmonic – being received by the RF Detector.

4. The difference between the RF levels at the frequencies below and the frequencies above cutoff indicate the harmonic level of the useful frequency range. Record the value of this difference on the Test Record and compare it to the value noted as acceptable.

5. Repeat steps 1 through 4 for any other frequencies indicated on the Test Record.

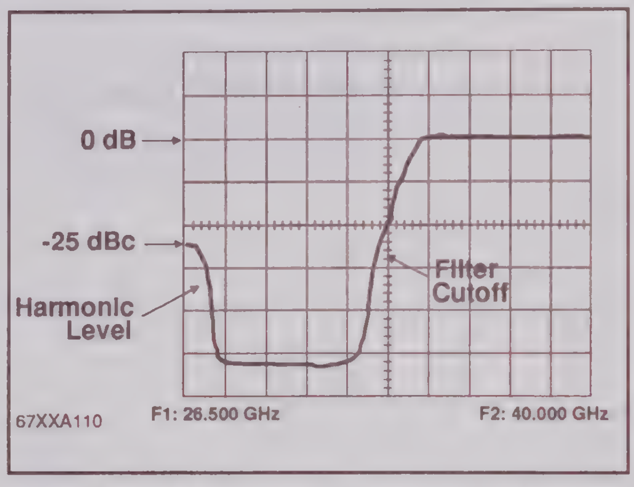


Figure 2-9. Typical Waveform for the Alternate Harmonic Test Procedure

NOTE

Figure 2-9 shows a typical 562 Network Analyzer display when sweeping from 26.5 to 40 GHz. The power on the left side of the screen represents the power of the 3/2 product (13.25 GHz × 3 = 39.75 GHz) and the second harmonic (26.5 GHz × 2 = 53 GHz). The power on the right side of the screen represents the total power, fundamental and harmonic, above the filter cutoff.

2-13 HARMONIC TEST: RF OUTPUT FROM 26.5 TO 40 GHz

a. Test Description

This test applies only to the following 67XXA models: 6740A, 6742A, 6763A, and 6769A. This test verifies that the 67XXA meets its harmonic specifications for RF Output signals from 26.5 to 40 GHz. This is accomplished by checking the level of the worst case harmonic related signal in the frequency band. The worst case harmonic related signal occurs at 26.5 GHz.

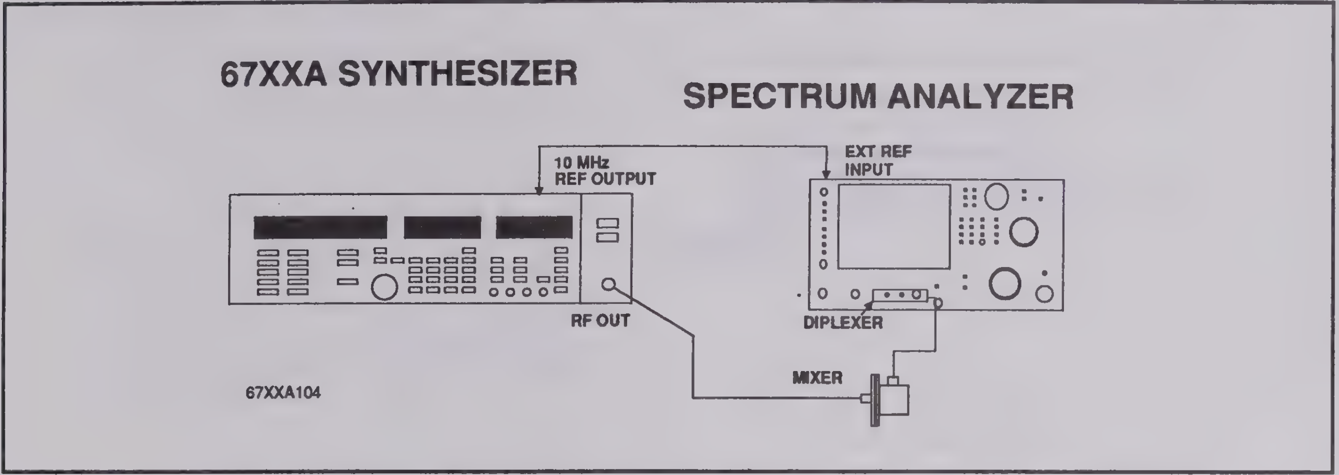


Figure 2-10. Equipment Setup for Harmonic Test: RF Output Signals From 26.5 to 40 GHz

b. Test Setup

1. Connect equipment as shown in Figure 2-10.
   (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   (b) Connect the Diplexer and External Waveguide Mixer to the Spectrum Analyzer.
   (c) Connect the 67XXA RF OUTPUT to the External Waveguide Input.

c. Test Procedure

1. Set up the 67XXA as follows:
   (a) Press <Shift> RESET.
   (b) Press CW OUTPUT SELECT.
   (c) Enter 39.75 GHz.
   (d) Set the output power to –30 dBm.

NOTE

If the 67XXA is not fitted with Option 2, install a 30 dB attenuator (Wiltron 43KC-20 and 43KC-10) and set the 67XXA output power to 0 dBm.

2. Set up the Spectrum Analyzer as follows:
   (a) CF: Set to 39.75 GHz
   (b) Span/Div: 5 kHz/div
   (c) RBW: 1 kHz
   (d) Wide Video Filter: ON

3. Adjust the Spectrum Analyzer Peaking control for maximum signal, then adjust the Reference Level control to place the signal at the top of the screen graticule. It may be necessary to also adjust the 67XXA output power slightly to accomplish this; however, *do not exceed –20 dBm output power.*

4. On the 67XXA, change the CW output frequency to 26.5 GHz.

5. Verify that the signal displayed on the Spectrum Analyzer is ≥ 20 dB below the top of the screen graticule.

6. Record the signal level on the Test Record.

2-14 POWER LEVEL ACCURACY AND FLATNESS VERIFICATION

a. Test Description

Power level verification is divided into two sections, accuracy and flatness. Power level flatness is initially checked by observing a full band sweep; first in step sweep, then in analog sweep. Power level accuracy is then checked by stepping the power down in twelve 1 dB increments from its maximum rated power level. Note that the Power Level Flatness in Analog Sweep is a typical value, not a specification.

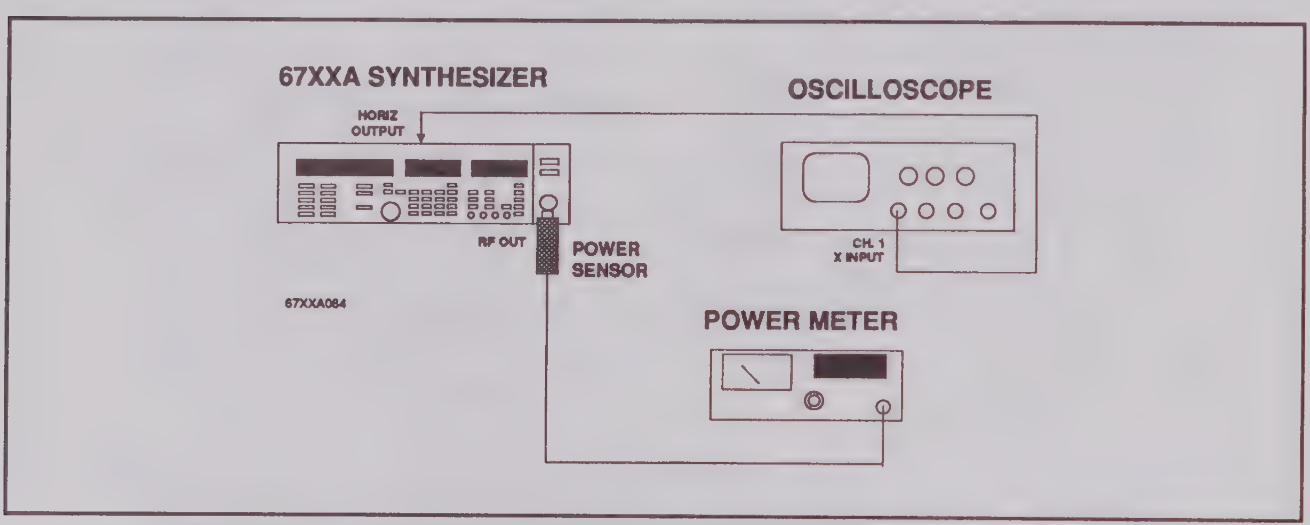


Figure 2-11. Equipment Setup for Power Level Accuracy and Flatness Verification

b. Test Setup

1. Connect the equipment as shown in Figure 2-11.
   - (a) Calibrate the Power Meter with the Power Sensor.
   - (b) Connect the Power Meter's Power Sensor to the RF OUTPUT of the 67XXA.
   - (c) Connect the 67XXA rear panel HORIZ OUTPUT to the Oscilloscope Ch.1 input (X-axis input).

NOTE

During this test it will be necessary to adjust the Power Meter's CAL FACTOR % setting as applicable for the frequency being tested.

c. Power Level Flatness Procedure

1. Set up the 67XXA for full band sweep at maximum rated power as follows:
   - (a) Press <Shift> RESET.
   - (b) Press F1-F2.
   - (c) Press STEP SWEEP DWELL TIME.
   - (d) Enter 1 sec.
   - (e) Select STEP SWEEP.

NOTE

Monitor the 67XXA's Horizontal Output on the Oscilloscope to determine sweep start and stop.

2. As the 67XXA steps through the full frequency range, measure and record the maximum and minimum Power Meter reading values on the Test Record. Verify that the variation (difference between the maximum and minimum readings) does not exceed the value noted on the Test Record.

3. Use the following 67XXA keystrokes to verify the accuracy and flatness of the analog sweep.
   - (a) Set the rear panel RETRACE RF switch to ON.
   - (b) Press TRIGGER twice to light the EXT indicator.
   - (c) Press ANALOG SWEEP.
   - (d) Press <Shift> ANALOG SWP TIME.
   - (e) Enter 99 Sec.
   - (f) Press SINGLE SWEEP to initiate a sweep.

4. During the analog sweep, measure and record the maximum and minimum Power Meter reading values on the Test Record. Verify that the variation (difference between the maximum and minimum readings) does not exceed the value noted on the Test Record.

NOTE

Repeat section d as needed to cover all of the installed bands in the 67XXA instrument under test. The Test Record lists the specific bands that need to be tested.

d. Power Level Accuracy Procedure

1. To set up the 67XXA for the power level accuracy procedure:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT.
   - (c) Enter the CW Frequency noted in the Test Record.
   - (d) Press LEVEL 1.
   - (e) Press SET INCR/DECR SIZE.
   - (f) Enter 1 dB.

2. Measure and record the Power Meter reading on the Test Record.

3. On the 67XXA, press DECR. Measure and record the Power Meter reading on the Test Record.

4. Repeat step d.3 with the other levels listed in the Test Record.

5. Repeat steps d.1 through d.4 for all installed bands as directed by the Test Record. Record the results of each on the Test Record.

2-15 FM MODULATION TESTS

a. Test Description

This procedure verifies the operation of the 67XXA frequency modulation input sensitivity circuit and accuracy of the front panel MODULATION display.

After calibrating a Function Generator's sine wave output (1 Vpeak; 0.707 Vrms) with a Digital Voltmeter, the signal is connected to the 67XXA's (front panel) EXT FM input. The RF OUTPUT of the 67XXA is monitored on a Spectrum Analyzer display. The magnitude of power carried in the FM sidebands is determined by the amount of signal decrease in the carrier level on the Spectrum Analyzer display. This qualifies how the FM input signal affects the synthesizer's RF OUPUT.

Once the FM circuit's proper operation is verified, the accuracy of the front panel MODULATION display is checked. The displayed FM deviation value (resulting from the previous FM sensitivity test) is noted. Then an FM sensitivity parameter (determined by computation from the displayed value) is entered to generate a carrier level decrease. The value of the decrease verifies the proper operation of the meter circuits.

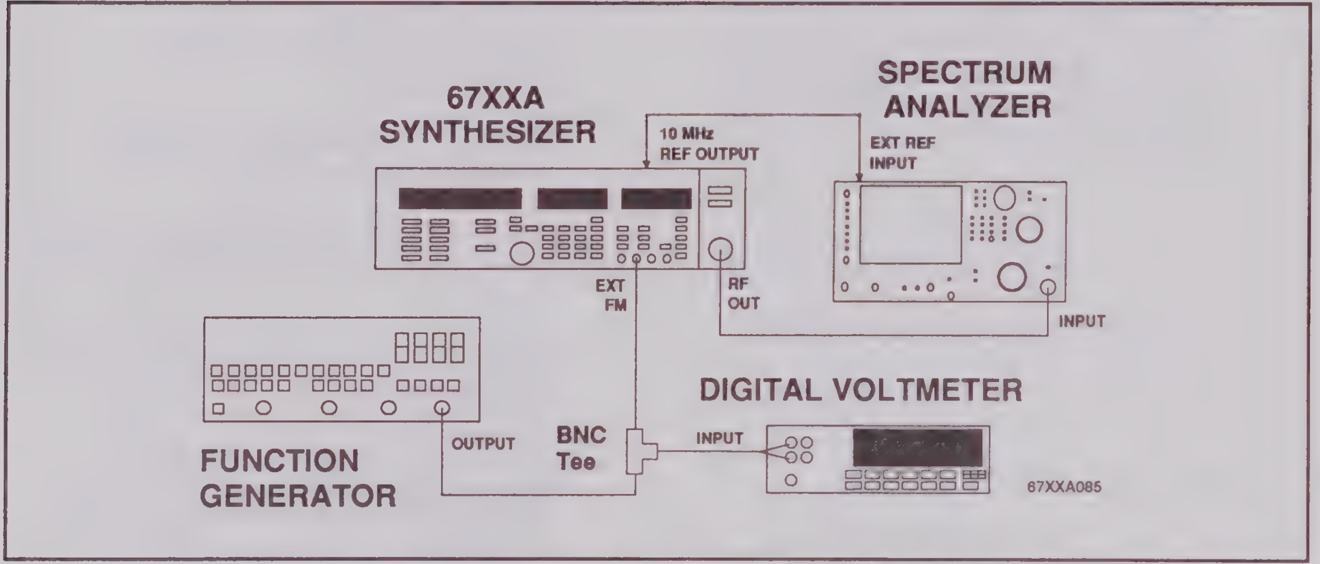


Figure 2-12. Equipment Setup for FM Modulation Tests (0.01 to 20 GHz)

b. Test Setup (for frequencies 0.01 to 20 GHz)

1. Connect the equipment as shown in Figure 2-12.
    - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
    - (b) Connect the Function Generator Output to the BNC tee. Connect one leg of the tee to the 67XXA front panel EXT FM input. Connect the other leg of the tee to the Digital Voltmeter input.
    - (c) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

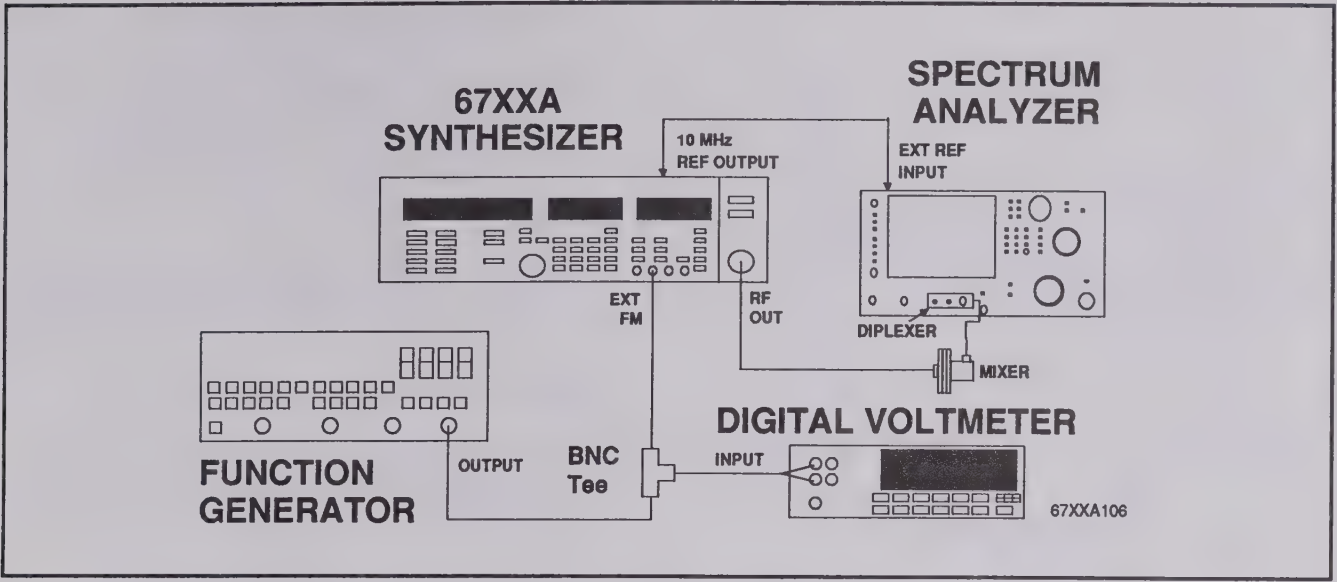


Figure 2-13. Equipment Setup for FM Modulation Tests (20 to 40 GHz)

c. Test Setup (for frequencies 20 to 40 GHz)

1. Connect the equipment as shown in Figure 2-13.
   - (a) Connect the 67XXA rear panel 10MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the Function Generator Output to the BNC tee. Connect one leg of the tee to the 67XXA front panel EXT FM input. Connect the other leg of the tee to the Digital Voltmeter input.
   - (c) Connect the Diplexer and the appropriate external Waveguide Mixer to the Spectrum Analyzer.
   - (d) Connect the 67XXA RF OUTPUT to the Waveguide Mixer input.

NOTE

Repeat section d as needed to cover all of the installed bands in the 67XXA instrument under test. The Test Record lists the specific bands that need to be tested.

d. FM Input Sensitivity Procedure

1. Adjust the Function Generator for a 40 kHz ±200 Hz sine wave, 0.707 Vrms ±0.5%, with no dc offset. The generator voltage must be set while connected to the 67XXA EXT FM input through the BNC tee.

2. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT.
   - (c) Enter the frequency noted on the Test Record.
   - (d) Press <Shift> FM SENS.
   - (e) Enter 96 kHz.

3. Set up the Spectrum Analyzer as follows:
   - (a) CF: Same as the 67XXA CW frequency set in step d.2(c)
   - (b) Span/Div: 10 kHz
   - (c) RBW: 1 kHz.
   - (d) Filter: Wide
   - (e) Reference Level: Adjust to place the signal at the top graticule of the display.

4. On the 67XXA, press FM.

5. Observe the first Bessel null (Figure 2-14) at the carrier frequency (modulation index = 2.4). Measure the drop in carrier level and record it on the Test Record. The carrier level must have decreased by ≥26 dB to meet specification.

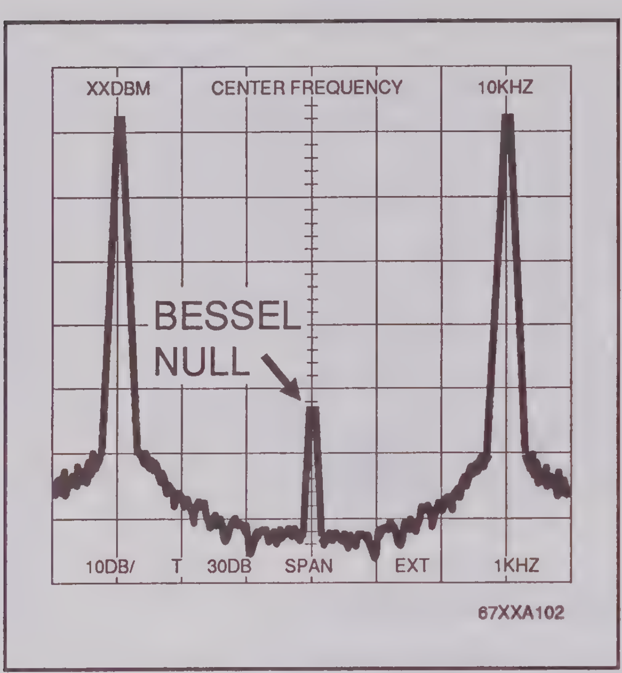


Figure 2-14. Typical Spectrum Analyzer Display of Bessel Null on FM Modulation Waveform

e. ***FM Meter Accuracy Procedure***

1. Press the MEASURE FM DEV key once (the key directly below the AM key). The MEASURE FM DEV indicator next to the key will light. Record the number shown in the MODULATION display in the Test Record.

2. Divide 9216 by the number recorded previously in step e.1. Record the result in the Test Record.

3. On the 67XXA, press <Shift> FM SENS.

4. Enter the calculated value from step e.2 above using the keypad. Then press the kHz key as the data terminator.

5. Measure the drop in carrier level and record it on the Test Record. The carrier level must have decreased by ≥26 dB to meet specification.

6. Repeat steps d.2 thru e.5 for all installed bands as directed by the Test Record. Record the results of each on the Test Record.

7. On the 67XXA, press <Shift> RESET.

2-16 AM MODULATION TESTS

a. Test Description

This procedure verifies the operation of the 67XXA amplitude modulation input sensitivity circuit and accuracy of the front panel MODULATION display.

After calibrating a Function Generator's sine wave output (1 Vpeak; 0.707 Vrms) with a Digital Voltmeter, the signal is connected to the 67XXA's (front panel) EXT AM input. The RF OUTPUT of the 67XXA is monitored on a Spectrum Analyzer display. The (modulated) IF Output of the Spectrum Analyzer is monitored with a Modulation Analyzer. A 30% AM modulation (default value) signal is set to a reference point on the Spectrum Analyzer. The actual modulation value is then computed from the indicated Modulation Meter values. (The absolute values of the AM PK+ and AM PK– readings are used in the given formula to compensate for non-linearity errors in the test equipment.)

Once the AM circuit's proper operation is verified, the accuracy of the front panel MODULATION display is checked. The displayed AM deviation value (resulting from the previous AM sensitivity test) is noted. Then a corresponding AM sensitivity parameter is determined by manual calculation. The comparison of the calculated value to the displayed value indicates the accuracy of the meter circuits.

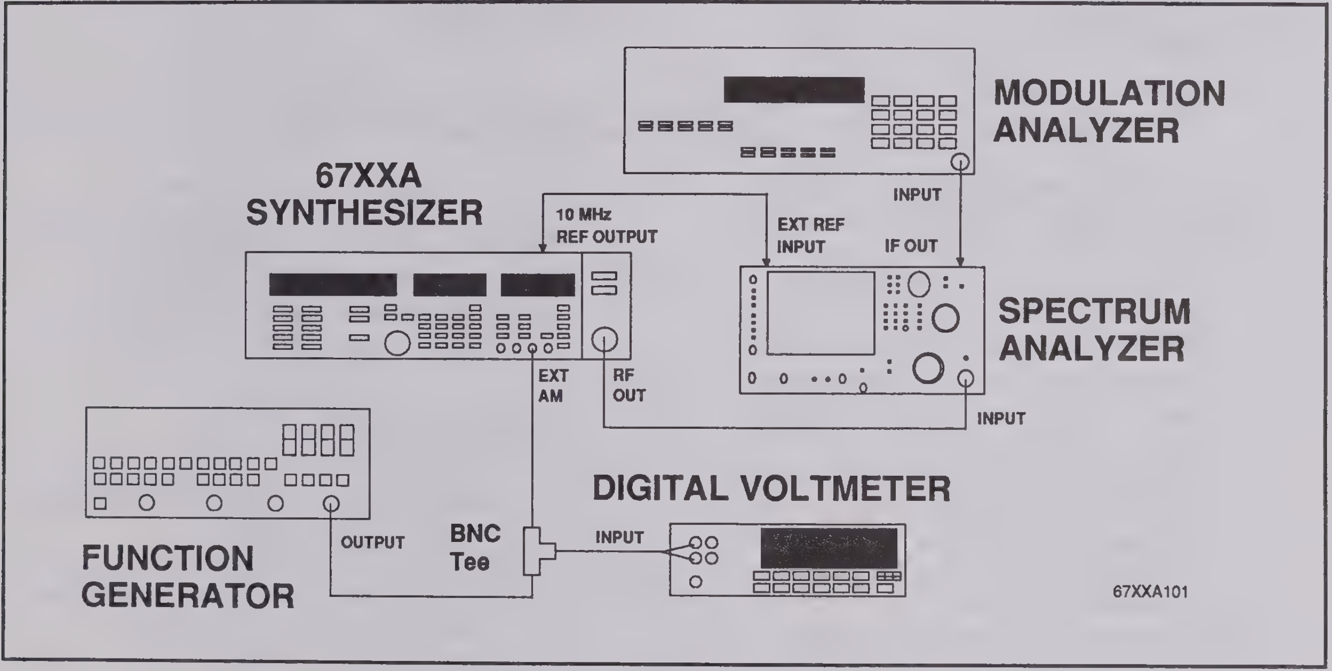


Figure 2-15. Equipment Setup for AM Modulation Tests (0.01 to 20 GHz)

b. Test Setup (for frequencies 0.01 to 20 GHz)

1. Connect the equipment as shown in Figure 2-15.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the Function Generator Output to the BNC tee. Connect one leg of the tee to the 67XXA front panel EXT AM input. Connect the other leg of the tee to the Digital Voltmeter input.
   - (c) Connect the IF Output of the Spectrum Analyzer to the RF Input of the Modulation Analyzer.
   - (d) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

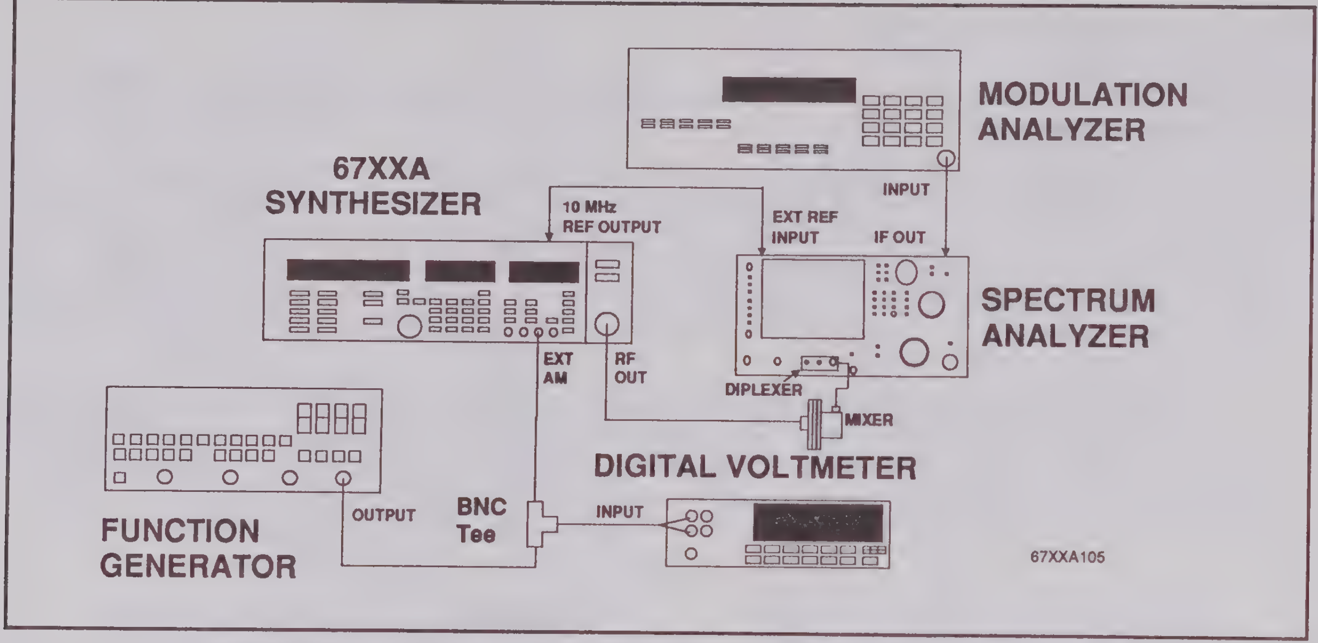

MODULATION ANALYZER
67XXA SYNTHESIZER
INPUT
10 MHz REF OUTPUT
EXT REF INPUT
IF OUT
SPECTRUM ANALYZER
EXT AM
RF OUT
DIPLEXER
MIXER
DIGITAL VOLTMETER
INPUT
OUTPUT
BNC Tee
FUNCTION GENERATOR
67XXA105

Figure 2-16. Equipment Setup for AM Modulation Tests (20 to 40 GHz)

c. ***Test Setup (for frequencies 20 to 40 GHz)***

1. Connect the equipment as shown in Figure 2-16.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the Function Generator Output to the BNC tee. Connect one leg of the tee to the 67XXA front panel EXT AM input. Connect the other leg of the tee to the Digital Voltmeter input.
   - (c) Connect the IF Output of the Spectrum Analyzer to the RF Input of the Modulation Analyzer.
   - (d) Connect the Diplexer and the appropriate external Waveguide Mixer to the Spectrum Analyzer.
   - (e) Connect the 67XXA RF OUTPUT to the Waveguide Mixer input.

NOTE

Repeat section d as needed to cover all of the installed bands in the 67XXA instrument under test. The Test Record lists the specific bands that need to be tested.

d. ***AM Input Sensitivity Procedure***

1. Connect the Digital Voltmeter to the Function Generator and adjust the output voltage for a 1 kHz sinewave, 0.707 Vrms ±0.5%, while the generator is connected to the EXT AM connector.

2. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) Press LEVEL 1.
   - (c) Enter a power level that is 4 dB below maximum rated power.
   - (d) Press CW OUTPUT SELECT.
   - (e) Enter the frequency noted on the Test Record.
   - (f) Press AM.

3. Set up the Spectrum Analyzer as follows:
   - (a) CF: Same as 67XXA CW frequency set in step d.2(e)
   - (b) Span/Div: 0 Hz (labeled as 10 mSec setting on Tektronix Model 494)
   - (c) RBW: 100 kHz
   - (d) MIN Noise: Activate

4. On the Spectrum Analyzer, adjust the reference level to place the trace 6 to 8 dB below the top graticule of the display.

5. Set up the Modulation Analyzer for:
   (a) AM PK (+)
   (b) 300 Hz High-Pass Filter
   (c) 3 kHz Low-Pass Filter

6. Measure the peak AM on the Modulation Analyzer. Note the AM PK(+) reading on the Test Record.

7. Press PK(–) on the Modulation Analyzer.

8. Measure the peak AM on the Modulation Analyzer. Note the AM PK(–) reading on the Test Record.

9. Compute the actual AM input sensitivity with the following formula:

$$\%AM = 100 \times \left[\frac{|AM\,PK(+)| + |AM\,PK(-)|}{200 + |AM\,PK(+)| - |AM\,PK(-)|} \right]$$

10. The calculated result should be between 26% and 34% AM. Note this result in the Test Record; it will be used in the AM Meter Accuracy check that follows.

e. AM Meter Accuracy Procedure

1. Complete steps d.1 through d.10 in the previous AM Input Sensitivity Procedure.

2. Press the MEASURE AM DEPTH key twice to light the indicator next to the MEASURE AM DEPTH key label.

3. Record on the Test Record the number shown in the MODULATION display.

4. Divide 30 by the number recorded in the previous step. Calculate the result to a three-digit accuracy and record it on the Test Record.

5. Multiply the result of step 4 above by the result obtained in step 10 of the AM Input Sensitivity Procedure. Record this result on the Test Record. The product of the calculation must be between 26% to 34% AM.

6. Repeat steps d.2 through e.5 for all installed bands as directed by the Test Record. Record the results of each in the Test Record.

7. On the 67XXA, press <Shift> RESET.

2-17 PULSE MODULATION TESTS: RISE TIME, FALL TIME, OVERSHOOT, AND LEVEL

a. Test Description

Pulse modulation tests verify correct operation as well as rise time, fall time, overshoot, and leveling.

The Pulse Leveling Accuracy test compares the pulsed RF output level to the CW output level to verify the performance of the level detector(s), detector/preamplifier(s), and ALC sample/hold circuits. The 67XXA LEVEL display power meter reading is calibrated with an external power meter. Any minor displayed power difference is offset before the test is performed.

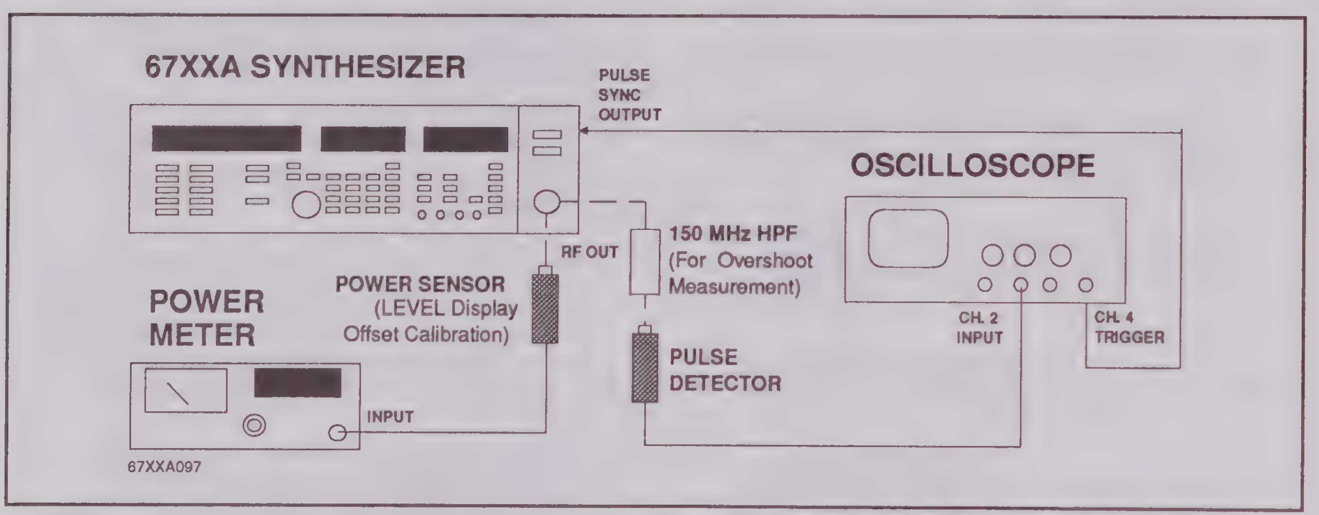


Figure 2-17. Equipment Setup for Pulse Modulation Tests: (Rise Time, Fall Time, Overshoot, and Level)

b. Test Setup

1. For all models, connect the equipment as shown in Figure 2-17.
   (a) Connect the 67XXA rear panel PULSE SYNC OUTPUT to the Oscilloscope Trigger Input.
   (b) Connect the Pulse Detector Output to the Vertical Input of the Oscilloscope.
   (c) On the Oscilloscope select 50Ω input impedance.
   (d) Connect the Pulse Detector Input through a 150 MHz High Pass Filter to the 67XXA RF OUTPUT.

NOTE

Repeat section c as needed to cover all of the installed bands in the 67XXA instrument under test. The Test Record lists the specific bands that need to be tested.

c. Rise Time, Fall Time, Overshoot, and Level Test Procedure

1. Set up the 67XXA as follows:
   (a) Press <Shift> RESET.
   (b) Press CW OUTPUT SELECT.
   (c) Enter the frequency noted in the Test Record.
   (d) Press INT PULSE.
   (e) Press <Shift> INT WIDTH.
   (f) Enter 5 µs.
   (g) Press <Shift> INT RATE.
   (h) Enter 50 kHz.

2. Observe the output of the Pulse Detector on the Oscilloscope. Refer to Figure 2-18 to interpret the detector waveform. Adjust the Oscilloscope controls to measure and record on the Test Record the following:
   (a) Rise Time: <10 ns
   (b) Pulse Width: 5 µs (±10 ns, typical)
   (c) Pulse Rate: 50 kHz
   (d) Overshoot: <10% (typical)

3. Repeat step c.2 for all installed bands as directed bythe Test Record. Record the results of each on the Test Record.

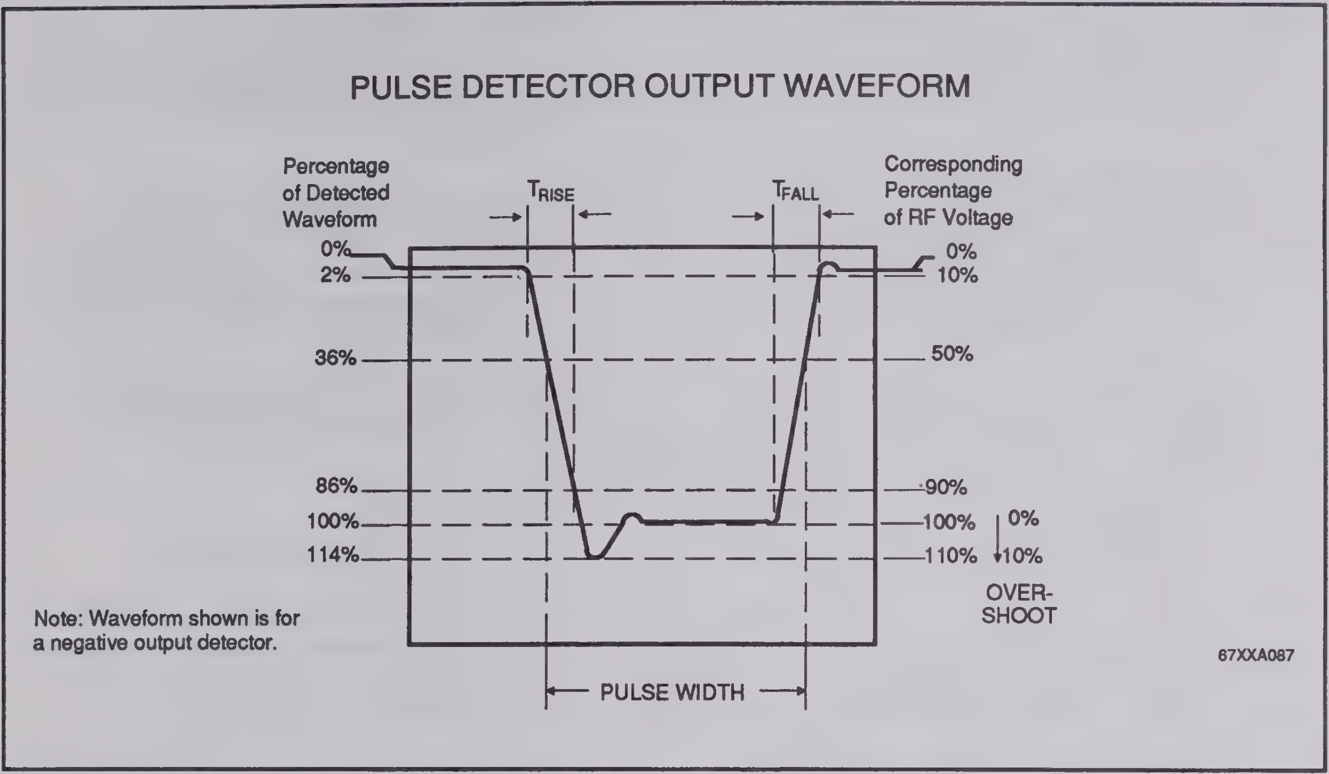

PULSE DETECTOR OUTPUT WAVEFORM
Percentage of Detected Waveform
0%
2%
36%
86%
100%
114%
T_RISE
T_FALL
Corresponding Percentage of RF Voltage
0%
10%
50%
90%
100%
110%
0%
10%
OVER-SHOOT
PULSE WIDTH
Note: Waveform shown is for a negative output detector.
67XXA087

Figure 2-18. Measurement Parameters for Pulse Modulation Waveform

d. Pulse Leveling Accuracy Check
Preliminary Test Setup

1. Set up the test equipment as described in step b.1. In addition, do the following:
   (a) Properly calibrate the Power Meter with the Power Sensor.

   NOTE

   For 67XXA models with frequency range of ≤20 GHz use Power Sensor HP 8484A. For 67XXA models with frequency range >20 GHz use Power Sensor HP 8485A; for frequency range 26.5 to 40 GHz use Power Sensor HP R8486A.

   (b) Disconnect the Pulse Detector from the 67XXA RF OUTPUT and connect the Power Meter's Power Sensor in its place.

2. On the 67XXA:
   (a) Press LEVEL 1.
   (b) Press SET INCR/DECR.
   (c) Enter .01 dBm.

3. On the 67XXA, press INT PULSE to turn pulse modulation off (turned on in step c.1(d); the INT PULSE indicator should go out. The 67XXA is now generating a CW output frequency.

4. On the 67XXA change the CW output frequency as follows:
   (a) Press CW OUTPUT SELECT.
   (b) Enter the frequency noted in the Test Record.

e. 67XXA LEVEL Display Calibration

1. Note the value displayed in the 67XXA LEVEL display on the Test Record. Then Press LEVEL 1.

2. Using the 67XXA INCR and DECR keys, adjust the synthesizer's power output in 0.01 dB increments until the value in the the Power Meter's display matches the value previously noted in step e.1. Note this level on the Test Record.

3. On the Test Record, compute the difference of the readings noted in steps e.1 and e.2.

4. On the 67XXA:
   (a) Press <Shift> ENTER OFFSET.
   (b) Enter the value recorded in step e.3.
   (c) Press LEVEL OFFSET.
   (d) Press LEVEL 1.
   (e) Press SET INCR/DECR.
   (f) Enter .1 dBm.
   (g) Press LEVEL OFFSET twice.

5. The 67XXA LEVEL display reading should now indicate and track the power meter display reading to within 0.1 dB as the test procedure is performed.

f. Pulse Leveling Accuracy Test Procedure

1. Disconnect the Power Sensor and reconnect the Pulse Detector to the 67XXA RF OUTPUT.

2. On the 67XXA change the CW output frequency as follows:
   (a) Press CW OUTPUT SELECT.
   (b) Enter the frequency noted in the Test Record.

3. On the Oscilloscope:
   (a) Adjust the vertical offset to place the trace exactly on the center graticle; this is used as the CW-level reference line.
   (b) Use the Auto Triggering mode to continue sweeping the display when the pulse is off.
   (c) Adjust the vertical sensitivity to the most sensitive setting (mV/div) possible while keeping the trace at the center graticule reference line.

4. On the 67XXA:
   (a) Press INT PULSE.
   (b) Press <Shift> INT WIDTH.
   (c) Enter the pulse width noted in the Test Record.

5. On the Oscilloscope, observe that the nominal level of the displayed pulse peak has shifted vertically, slightly off of the centerline. It may be necessary to readjust scope trigger level.

6. Record the value indicated on the 67XXA LEVEL display on the Test Record.

7. On the 67XXA:
   (a) Press LEVEL 1.
   (b) Press SET INCR/DECR SIZE.
   (c) Enter 0.1 dB.
   (d) Press INCR or DECR key a few times until the nominal peak level is evenly centered on the display centerline reference.

8. Record the value indicated on the 67XXA LEVEL display on the Test Record.

9. Subtract the LEVEL display reading recorded in step f.8 from the reading recorded in step f.6. This is the pulse level error. Record it on the Test Record.

10. On the 67XXA:
    (a) Press INT PULSE (Indicator off).
    (b) Press LEVEL 1 and return to Level display noted in step f.6.

11. Repeat steps f.2 through f.9 for the remaining frequencies and pulse widths noted in the Test Record. Record the results on the Test Record.

2-18 PULSE MODULATION TEST: VIDEO FEEDTHROUGH

a. Test Description

This pulse modulation test verifies that video feedthrough is within specifications.

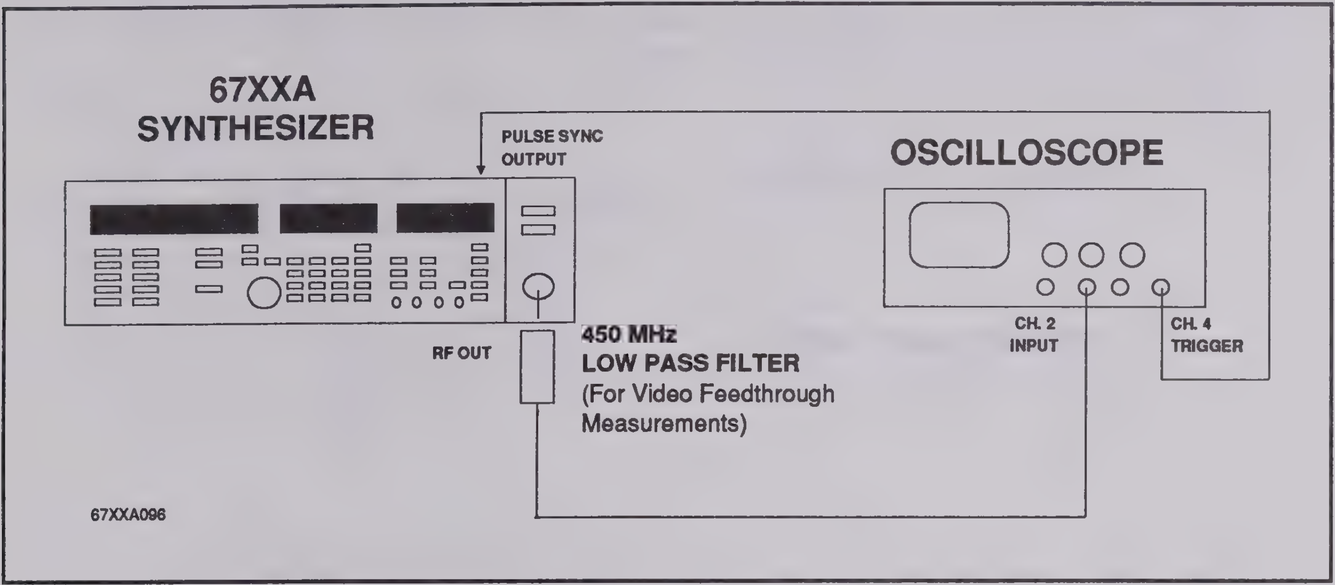


Figure 2-19. Equipment Setup for Pulse Modulation Test: Video Feedthrough

b. Test Setup

1. Connect the equipment as shown in Figure 2-19.
   - (a) Connect the 67XXA rear panel PULSE SYNC OUTPUT to the Oscilloscope Trigger Input.
   - (b) On the Oscilloscope select 50 Ω input impedance.
   - (c) Connect the 67XXA RF OUTPUT to the Oscilloscope Vertical Input through a 450 MHz Low Pass Filter.

NOTE

Repeat section c as needed to cover all of the installed bands in the 67XXA instrument under test. The Test Record lists the specific bands that need to be tested.

c. Test Procedure

1. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT.
   - (c) Enter the frequency noted on the Test Record.
   - (d) Press INT PULSE.
   - (e) Press <Shift> INT WIDTH.
   - (f) Enter 5 μs.
   - (g) Press <Shift> INT RATE.
   - (h) Enter 100 kHz.

2. Set the Oscilloscope controls as follows:
   - (a) Vertical Sensitivity: 5 mV/division
   - (b) External Trigger: On the positive slope of the Channel 1 signal input
   - (c) Horiz Time Base: 1 μSec/division

NOTE

Use the Oscilloscope's 20 MHz bandwidth limit to aid in viewing the voltage spikes. It may be necessary to adjust the Oscilloscope's horizontal level as any ripple or voltage spikes are generally very small in amplitude.

3. Measure and record the voltage spikes (video feedthrough) on the Test Record. They must be <±5 mVpeak to meet specification.

4. Repeat steps c.1 through c.3 for all installed bands as directed by the Test Record. Record the results of each on the Test Record.

2-19 PULSE MODULATION TEST: RF ON/OFF RATIO

a. Test Description

This pulse modulation test verifies that the ratio of RF on power to RF off power is within specifications. For frequencies 0.01 to 20 GHz use the section b test setup and section c test procedure. For frequencies 20 to 40 GHz use section d test setup and section e test procedure.

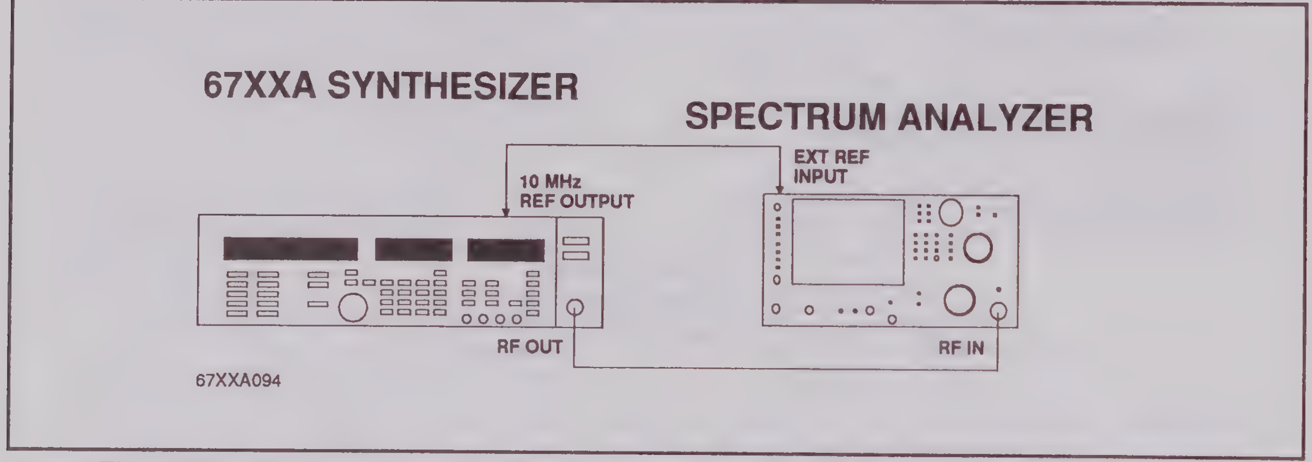


Figure 2-20. Equipment Setup for Pulse Modulation Test: RF ON/OFF Ratio (0.01 to 20 GHz)

b. Test Setup (for frequencies 0.01 to 20 GHz)

1. Connect the equipment as shown in Figure 2-20.
   (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   (b) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

NOTE

Repeat section c as needed to cover all of the installed bands in the 67XXA instrument under test. The Test Record lists the specific bands that need to be tested.

c. Test Procedure (for frequencies 0.01 to 20 GHz)

1. Set up the 67XXA as follows:
   (a) Set the rear panel ±PULSE switch to +PULSE.
   (b) Press <Shift> RESET.
   (c) Press CW OUTPUT SELECT.
   (d) Enter the frequency noted on the Test Record.
   (e) Press EXT PULSE.

2. Set up the spectrum analyzer as follows:
   (a) CF: Same as the 67XXA CW frequency noted in step c.1(d)
   (b) Span/Div: 10 kHz
   (c) RBW: 1 kHz
   (d) Video Filter: Wide
   (e) MIN Noise: Activated
   (f) Reference Level: Adjust to place the signal at the top graticule of the screen.

3. Connect a Short between the 67XXA front panel PULSE/GATE TTL BNC connector center and outer conductors.

4. On the Spectrum Analyzer, decrease the Reference Level by 20 dB, then measure the signal amplitude and record it on the Test Record. The measured signal must be ≥60 dB from the top graticule.

NOTE

A 60 dB level change plus a 20 dB decrease in the reference level equals an 80 dB on/off ratio (specification).

5. If the signal level drifts slowly after connecting the Short, remove the Short momentarily and apply it again. (Make the measurement as soon as possible after applying the Short.) This drift is due to the Sample/Hold circuit not holding the level because of the pulse duty factor (ratio of RF ON to RF OFF). This drift will not be present in normal pulse operation as the minimum pulse repetition rate is 10 Hz.

6. Remove the Short.

7. Repeat steps c.1 thru c.5 for all installed bands (for frequencies 0.01 to 20 GHz) as directed by the Test Record. Record the results of each on the Test Record. For 67XXA instruments with installed frequency bands above 20 GHz proceed to the Section d Test Setup and Section e Test Procedure as directed by the Test Record.

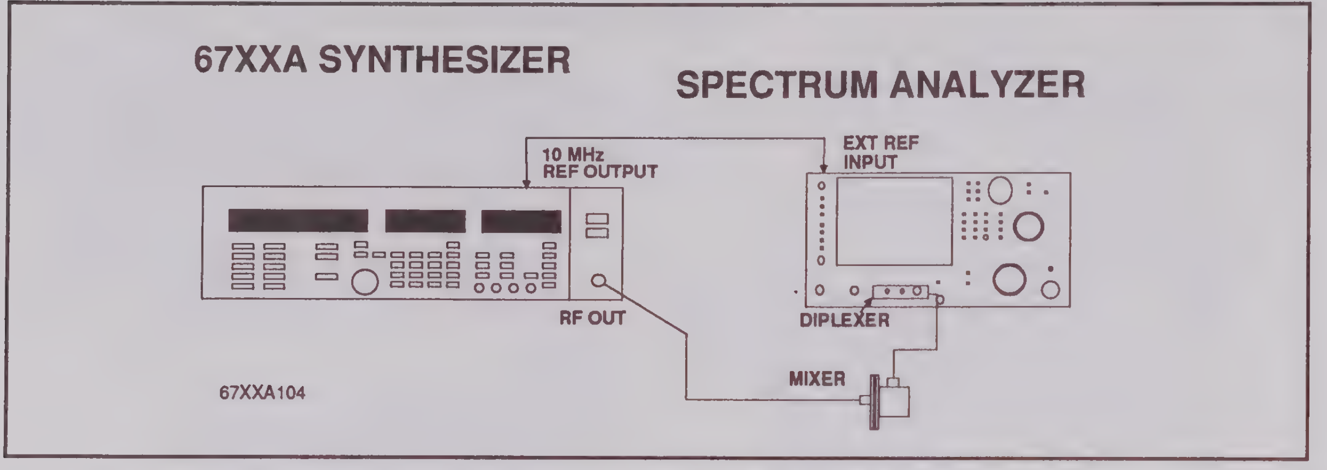


Figure 2-21. Equipment Setup for Pulse Modulation Test: RF ON/OFF Ratio (20 to 40 GHz)

d. Test Setup (for frequencies 20 to 40 GHz)

1. Connect the equipment as shown in Figure 2-21.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the diplexer and the appropriate external waveguide mixer to the Spectrum Analyzer.
   - (c) Connect the 67XXA RF OUTPUT to the waveguide mixer input.

NOTE

Repeat section e as needed to cover all of the installed bands in the 67XXA instrument under test. The Test Record lists the specific bands that need to be tested.

e. Test Procedure (for frequencies 20 to 40 GHz)

1. Set up the 67XXA as follows:
   - (a) Set the rear panel ±PULSE switch to +PULSE.
   - (b) Press <Shift> RESET.
   - (c) Press CW OUTPUT SELECT.
   - (d) Enter the frequency noted on the Test Record.
   - (e) Set the output power to –30 dBm.

NOTE

If the 67XXA is not fitted with Option 2, install a 30 dB attenuator (Wiltron 43KC–20 and 43KC–10) and set the 67XXA output power to 0 dBm.

   - (f) Press EXT PULSE.

2. Set up the Spectrum Analyzer as follows:
   - (a) CF: Same as the 67XXA frequency noted in step e.1.(d).
   - (b) Span/Div: 10 kHz
   - (c) RBW: 1 kHz
   - (d) Video Filter: Wide
   - (e) MIN Noise: Activated
   - (f) Reference Level: Adjust to place the signal at the top graticule of the screen.

3. Connect a Short between the 67XXA front panel PULSE/GATE TTL BNC connector center and outer conductors.

4. On the 67XXA, remove 30 dB of attenuation from the RF output. Do this by either increasing the output power 30 dB or by removing the 30 db attenuator installed in step e.1.(e). On the Spectrum Analyzer, verify that the measured signal is ≥40 dB from the top of the screen.

   NOTE

   40 dB plus a 30 dB increase in the 67XXA output level equals a 70 dB RF on/off ratio (specification).

5. If the signal level drifts slowly after connecting the Short, remove the Short momentarily and apply it again. (Make the measurement as soon as possible after applying the Short.) This drift is due to the Sample/Hold circuit not holding the level because of the pulse duty factor (ratio of RF ON to RF OFF).

6. Remove the Short.

7. Repeat steps e.1 thru e.5 for all installed bands as directed by the Test Record. Record the results of each on the Test Record.

SECTION III
CALIBRATION / ADJUSTMENTS

CONTENTS

Paragraph	Description	Page
3-1	INTRODUCTION	3-3
3-2	RECOMMENDED TEST EQUIPMENT	3-3
3-3	CALIBRATION/ADJUSTMENT TEST RECORD	3-3
3-4	STATIC HANDLING PROCEDURES	3-3
3-5	CALIBRATION/ADJUSTMENTS FOLLOWING COMPONENT REPAIR OR REPLACEMENT	3-3
3-6	CONNECTOR AND KEY LABEL NOTATION	3-3
3-7	HIDDEN–KEY ROUTINES	3-4
3-8	GENERATING EEPROM CHECKSUMS FOLLOWING CALIBRATION	3-4
3-9	POWER SUPPLY INJECTION-LOCK ADJUSTMENT	3-10
3-10	ALC LEVEL OFFSET ADJUSTMENTS	3-12
3-11	EXTERNAL LEVELING OFFSET ADJUSTMENT	3-14
3-12	10 MHz REFERENCE OSCILLATOR CALIBRATION	3-15
3-13	ALC BANDWIDTH CALIBRATION	3-17
3-14	ANALOG SWEEP CALIBRATION	3-19
3-15	FM DRIVER CALIBRATION	3-20
3-16	YIG-TUNED OSCILLATOR FREQUENCY CALIBRATION	3-21
3-17	RF LEVEL CALIBRATION	3-23
3-18	ALC SLOPE CALIBRATION	3-24
3-19	AM SENSITIVITY CALIBRATION	3-26
3-20	AM METER CALIBRATION	3-29
3-21	FM SENSITIVITY CALIBRATION	3-31
3-22	FM FLATNESS CALIBRATION	3-34
3-23	FM METER CALIBRATION	3-37

SECTION III
CALIBRATION/ADJUSTMENTS

3-1 INTRODUCTION

This section contains calibration and adjustment procedures for 67XXA Swept Frequency Synthesizers. These procedures are typically accomplished due to out-of-tolerance conditions having been noted during performance verification testing (see Section II) or as a result of the repair or replacement of subassemblies or microwave components.

NOTE

> The calibration procedures herein use hidden-key routines that were implemented with version 6.10 operating firmware. It is recommended that you upgrade your instrument's operating firmware to the latest available version prior to calibration. For assistance in calibrating instruments containing older versions of operating firmware or for firmware upgrade details, contact Wiltron Customer Service at (408) 778-2000.

3-2 RECOMMENDED TEST EQUIPMENT

Table 3-2 lists the test equipment required for these calibration and adjustment procedures.

The procedures refer to specific test equipment front panel control labels when the setup parameters of the procedure are critical to making accurate measurements. In some cases, the user may substitute equipment having the same critical specifications as those of the recommended test equipment listed in Table 3-2.

Contact the WILTRON Custromer Service department at (408) 778-2000 if you need clarification of any equipment or procedural reference.

3-3 CALIBRATION/ADJUSTMENT TEST RECORD

A blank copy of a sample calibration/adjustments test record is provided in Section IV, Test Records. The test record contains model-specific variables called for by the procedures in this section and provides the means for maintaining an accurate and complete record of calibration/adjustments to the instrument. We recommend that you copy these pages and record on them the results from: (1) your initial calibration/adjustment of out-of-tolerance 67XXA circuits, or (2) your initial calibration/adjustment of the 67XXA following repair or replacement of subassemblies or microwave components. These initial readings can later be used as benchmark values for future tests of the same serial-numbered instrument.

3-4 STATIC HANDLING PROCEDURES

The 67XXA contains components that can be damaged by static electricity. Figure 6A-1 (see Section VI) provides a list of precautions that, when followed, will minimize the possibilities of static-shock damage to components.

3-5 CALIBRATION/ADJUSTMENTS FOLLOWING COMPONENT REPAIR OR REPLACEMENT

Table 3-1 lists the calibration/adjustments that should be performed following the repair or replacement of 67XXA subassemblies or microwave components.

3-6 CONNECTOR AND KEY LABEL NOTATION

The calibration and adjustment procedures include many references to equipment interconnections and control settings. For all 67XXA references, specific labels are used to denote the appropriate control key or connector (such as CW OUTPUT SELECT or RF OUTPUT). Most references to supporting test equipment use general labels for commonly used controls and connections (such as Span or RF Input). In some cases, a specific label is used that is a particular feature of the test equipment listed in Table 3-2.

Many of the 67XXA front panel control keys, when pressed, cause an LED indicator next to the key to light verifying the selection. Observe the lighting of the LED indicator to ensure that the desired function is enabled.

During calibration/adjustment procedures, three additional LED indicators that should be monitored are the ENTRY ACTIVE, RF UNLEVELED, and NOT Ø-LOCKED indicators. The lighting on the ENTRY ACTIVE LED indicates that the Data Entry function is active. When in the step sweep or CW modes of operation, the lighting of the RF UNLEVELED LED or NOT Ø-LOCKED LED may signal a situation that is the result of an instrument failure and may cause errant calibration/adjustment results.

3-7 HIDDEN-KEY ROUTINES

The <Shift> TRIGGER key in conjunction with a 3 digit code inplements the 67XXA's hidden-key routines. These routines are used in calibration and troubleshooting. Table 3-3 provides descriptions of the routines used in calibration. Once a hidden-key routine has been activated, the keys used (except for the DATA ENTRY keypad) have different functions than are indicated by the 67XXA's front panel markings.

Care must be exercised when entering <Shift> TRIGGER codes during calibration or troubleshooting procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

3-8 GENERATING EEPROM CHECKSUMS FOLLOWING CALIBRATION

During calibration procedures, calibration data is stored in the non-volatile memory (EEPROMs) located on the A23 Microprocessor PCB. Upon completion of 67XXA calibration, you should generate new checksums for the EEPROMs. Failure to do so will result in checksum error codes E23-17, E23-18, and E23-19.

EEPROM checksums are generated by (1) placing the CAL/NORM jumper on the A23 Microprocessor PCB in the CAL position and (2) pressing <Shift> TRIGGER 089, then <Shift> TRIGGER 397. The EEPROM checksums have now been generated. Restore the CAL/NORM jumper to the NORM positon.

Table 3-1. Calibration/Adjustments Following 67XXA Component Repair or Replacement

If a Repair or Replacement Action Was Made To:	Perform the Following Adjustment(s) or Calibration(s) in Paragraph(s):
A1 Front Panel PCB	None
A2 Front Panel Control PCB	3-11
A3 Coarse Loop Mixer PCB	None
A4 Coarse Loop Oscillator PCB	See troubleshooting in section 6H for calibration/adjustment procedures.
A5 Reference Oscillator PCB	See troubleshooting in section 6G for calibration/adjustment procedures.
A6 Coarse Loop Divider PCB	None
A7 Reference Divider PCB	None
A8 Serial I/O PCB	None
A9 Fine Loop Oscillator PCB	None
A10 Reference Buffer PCB	None
A11 Fine Loop Divider PCB	None
A12 YIG Phase Detector PCB	3-22
A13 Pulse Generator PCB	None
A15 ALC PCB	3-10, 3-13, 3-17, 3-18, 3-19, 3-20
A16 FM PCB	3-14, 3-15, 3-16, 3-21, 3-22, 3-23
A17 Analog Instruction PCB	3-14, 3-16
A18 thru A21 YIG Driver PCBs	3-15, 3-16, 3-21, 3-22
A22 Regulator Interface PCB	None
A23 Microprocessor PCB	3-13 thru 3-23. None, if firmware EEPROMs are reused.
A24 GPIB PCB	None
A25 Switching Power Supply PCB	3-9
A27 Aux I/O PCB	None
A28 Motherboard PCB	None
A29 Rear Panel Interface PCB	3-13, 3-18
A30 Sampler/IF Amplifier PCB	None
A31 Power Amplifier PCB	None
Any YIG-tuned Oscillator	3-13, 3-15, 3-16, 3-21, 3-22
Any Isolator	3-13
Any Control Modulator	3-13
Any Low Pass Filter	3-13
0.01 to 2 GHz Downconverter	3-13, 3-17, 3-18
Switched Filter	3-13
Frequency Doubler (26.5-to-40 GHz)	3-13
Main Multiplexer (PIN) Switch	3-13
Leveling Detector/Directional Coupler	3-13, 3-17, 3-18
Sampler Multiplexer (PIN) Switch	None
Any RF Amplifier (High Power Option) and/or Optional Step Attenuator	3-13, 3-18 (Step Attenuators Only)

Table 3-2. Recommended Test Equipment Used in the Calibration/Adjustments

INSTRUMENT	CRITICAL SPECIFICATION	RECOMMENDED MANUFACTURER/MODEL	REQUIRED FOR TEST(S)
Spectrum Analyzer with Diplexer and External Mixers	*Frequency:* 0.01 to 40 GHz *Resolution:* 30 Hz	Tektronix, Model 494P Ext. Mixer PNs: WM 490K (18 to 26.5 GHz) WM 490A (26.5 to 40 GHz) Diplexer PN: 015-3085-00	3-19, 3-21, 3-22
Frequency Counter	*Frequency:* 0.01 to 40 GHz *Input Impedance:* 50Ω *Resolution:* 1 Hz *Other:* Ext Time Base Input	EIP Microwave, Inc. Model 578A, Option 91	3-12, 3-16
Digital Voltmeter	*Resolution:* 4-1/2 digits (to 20V) *DC Accuracy:* 0.002% + 2 counts *DC Input Impedance:* 10 MΩ *AC Accuracy:* 0.07% + 100 counts (to 20 kHz) *AC Input Impedance:* 1 MΩ	John Fluke, Inc. Model 8840A With Option 8840A-09 (True RMS AC)	3-10, 3-11, 3-13, 3-19, 3-20, 3-21, 3-22, 3-23
Frequency Standard	*Frequency:* 10 MHz *Accuracy:* 1 x 10^{-10} parts/day	Spectracom Corp. Model 8161	3-12
Function Generator	*Output Voltage:* 300 mV to 10V *Functions:* 200 kHz sine wave, 100 Hz square wave	Hewlett-Packard Model 8116A	3-13, 3-19, 3-20, 3-21, 3-22, 3-23
Oscilloscope	*Bandwidth:* dc to 150 MHz *Sensitivity:* 2 mV *Horiz. Sensitivity:* 50 ns/division	Tektronix, Inc. Model 2445	3-9, 3-13
Scalar Network Analyzer	*Frequency Range:* 0.01 to 40 GHz	Wiltron Model 562, with 560-7K50 Option 2 RF Detector	3-18
Microwave (Pulse) Detector	*Output Polarity:* Negative *Frequency Range:* dc to 40 GHz	Wiltron Company Model 75KC50	3-13
Modulation Analyzer	*Frequency Input:* 10 MHz (or the IF of the spectrum analyzer) *FM Max. Deviation:* 500 kHz *FM Accuracy:* ±1% to 100 kHz rate *AM Depth:* 0% to 90% *AM Mod. Rates:* dc to 100 kHz *AM Accuracy:* ± 3% *Filters:* 50 Hz lowpass, 15 kHz highpass	Hewlett-Packard Model 8901A	3-19
Tee	*Connectors:* 50Ω BNC	Any Common Source	3-13, 3-19, 3-20, 3-21, 3-22, 3-23
Cables	*Connectors:* 50Ω BNC	Any Common Source	All Tests

Table 3-3. Descriptions of Calibration Related Hidden-Key Routines (1 of 2)

<Shift> TRIGGER Code	Function
009	Displays the software version number in the FREQUENCY display. <Shift> exits this function.
050	Calibrates the ALC slope for the heterodyne band (<2 GHz).
051	Calibrates the ALC slope for the ≥2 GHz frequency bands.
089	Enables access to hidden-key routines that have <Shift> TRIGGER codes from 300 to 599. These routines are used in calibration or to check out the DACs to be calibrated.
300	Enables direct control of the A17 PCB Tune DAC. No calibration is performed.
301	Enables direct control of the A17 PCB Linearizer DAC. No calibration is performed.
302	Enables direct control of the A15 PCB ALC Level DAC. No calibration is performed.
303	Enables direct control of the A15 PCB ALC Level Range DAC. No calibration is performed.
305	Enables direct control of the A15 PCB External ALC Gain DAC. No calibration is performed.
306	Enables direct control and calibration of the A15 PCB %AM DAC (AM Sensitivity). (Code must be re-entered prior to calibration of each installed frequency band).
307	Enables direct control of the A16 PCB FM Sensitivity Cal DAC (FM Driver Output). No calibration is performed.
308	Enables direct control and calibration of the A16 PCB FM Attn DAC (FM Input Sensitivity). (Code must be re-entered prior to calibration of each installed frequency band).
309	Enables direct control of the A15 PCB ALC Slope DAC. No calibration is performed.
310	Enables direct control of the A17 PCB Sweep Width DAC. No calibration is performed.
312	Enables direct control of the A17 PCB Sweep Time DAC. No calibration is performed.
313	Enables direct control of the A17 PCB Marker/Switch Point DAC. No calibration is performed.
314	Enables direct control of the A29 PCB CW Horiz DAC. No calibration is performed.
315	Enables direct control of the A29 PCB V/GHz Width DAC. No calibration is performed.
316	Enables direct control of the A29 V/GHz Offset DAC. No calibration is performed.
317	Enables direct control and calibration of the A16 PCB Phase Mod Cal DAC (FM Flatness). (Code must be re-entered prior to calibration of each installed frequency band).
319	Enables direct control of the A17 PCB Linearizer DAC. No calibration is performed.
340	Calibrates the FM meter when there is no input voltage.
341	Calibrates the FM meter when there is a 1V peak (.707 Vrms) input.
342	Calibrates the AM meter when there is no input voltage.
343	Calibrates the AM meter when there is a 1V peak (.707 Vrms) input.
390	Zeros out the A17 PCB Linearizer DAC calibration.
391	Zeros out the frequency calibration for the C/S Band (2 to 8 GHz).
392	Zeros out the frequency calibration for the X Band (8 to 12.4 GHz).
393	Zeros out the frequency calibration for the Ku Band (12.4 to 20 GHz).
394	Zeros out the frequency calibration for the K Band (20 to 26.5 GHz).

Table 3-3. Descriptions of Calibraton Related Hidden-Key Routines (2 of 2)

<Shift> TRIGGER Code	Function
395	Zeros out the A16 PCB FM Attn DAC (FM Input Sensitivity) calibration.
396	Zeros out the A15 PCB %AM DAC (AM Sensitivity) calibration.
397	Generates memory checksum for the A23 PCB EEPROMs. Must be done anytime calibration of the 67XXA instrument is performed to eliminate checksum error codes.
398	Zeros out the AM meter calibration.
399	Zeros out the frequency calibration for the Ka Band (26.5 to 40 GHz).
400	Automatically calibrates the A16 PCB FM Sensitivity Cal DAC (FM Driver Output) for the current frequency band.
402	Calibrates the ALC bandwidth for each frequency band. (Code must be re-entered prior to calibration of each installed frequency band).
403	Automatically calibrates the analog sweep time, both the ≤1second and >1 second ranges.
404	Automatically calibrates the A16 PCB FM Sensitivity Cal DAC (FM Driver Output) for all installed frequency bands.
405	Automatically calibrates the paths used by analog sweeps.
406	Automatically calibrates the path used by narrow band sweeps (analog sweeps of ≤50 MHz).
460	Calibrates the YIG output frequency for each band. Code must be re-entered prior to calibration of each installed frequency band.

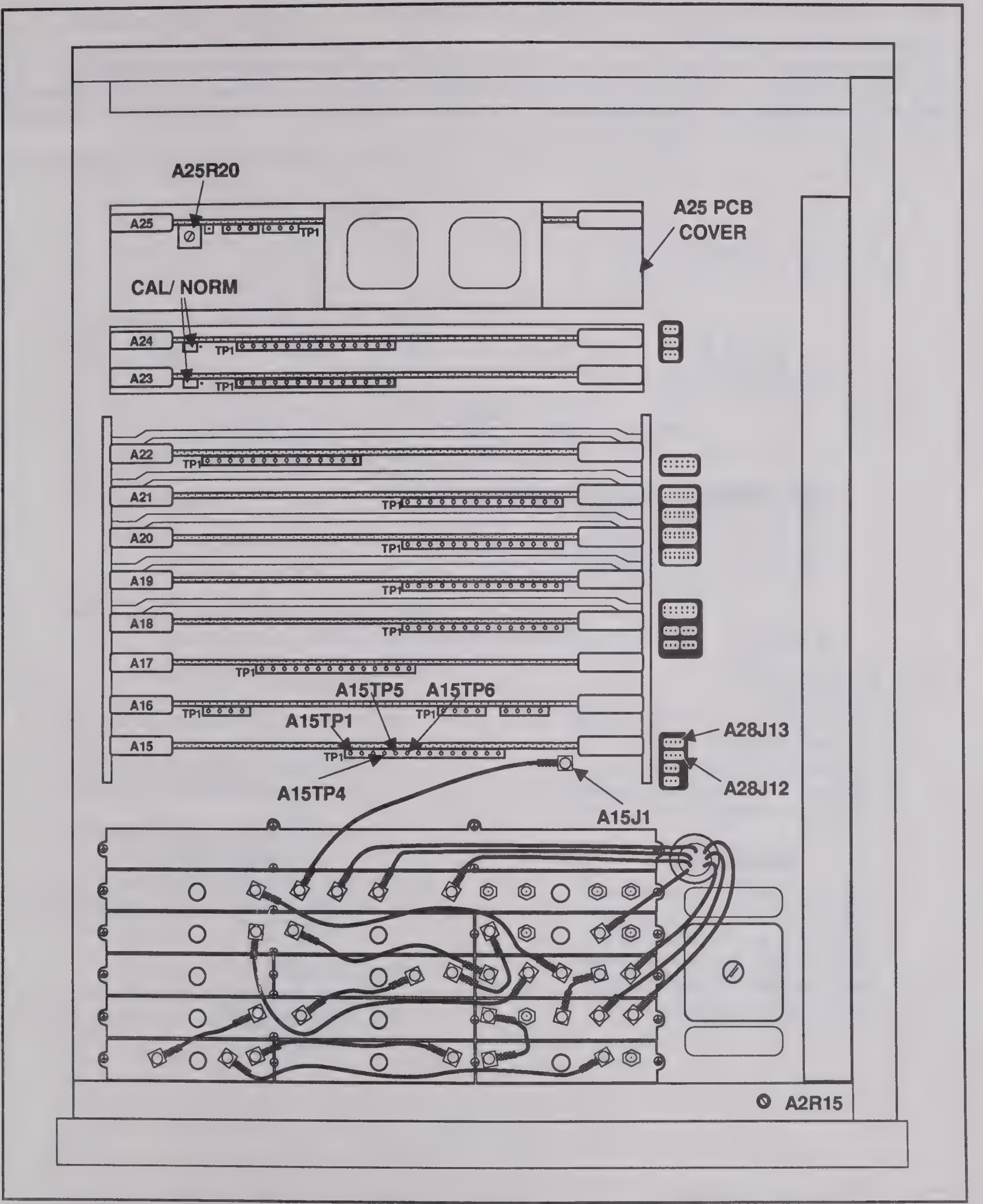

A25R20
A25
TP1
A25 PCB COVER
CAL/ NORM
A24
TP1
A23
TP1
A22
TP1
A21
TP1
A20
TP1
A19
TP1
A18
TP1
A17
TP1
A15TP5
A15TP6
A16
TP1
TP1
A15TP1
A28J13
A15
TP1
A28J12
A15TP4
A15J1
A2R15

Figure 3-1. Top View of 67XXA Showing Adjustment, Connector, and Test Point Locations

3-9 POWER SUPPLY INJECTION-LOCK ADJUSTMENT

a. Procedure Description

This procedure provides the steps necessary to perform the Power Supply Injection-Lock adjustment. This adjustment is required following replacement of the A25 Switching Power Supply PCB. The adjustment synchronizes the power supply's 50 kHz switching rate to the 10 MHz crystal oscillator reference to eliminate intermodulation products.

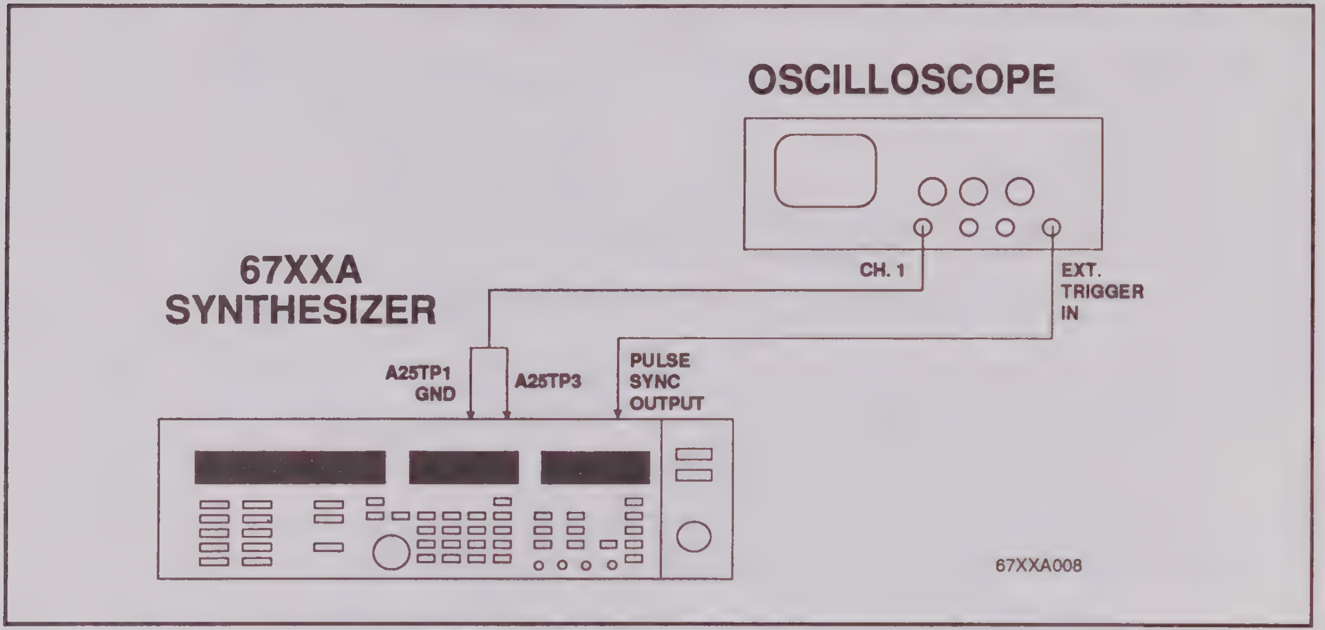


Figure 3-2. Test Equipment Setup for Power Supply Injection-Lock Adjustment

b. Test Equipment Setup

1. On the 67XXA:
    - (a) Press LINE key to STDBY (STDBY indicator will light).
    - (b) Disconnect the line power cord.
    - (c) Remove the cover from the A25 PCB housing (see Figure 3-1).

WARNING

Voltages hazardous to life are present when the cover is removed from the A25 housing. High-voltage connections on both the A25 PCB and the A25 heat sink are exposed.

2. Connect the equipment as shown in Figure 3-2.
    - (a) Connect the Oscilloscope Channel 1 to the 67XXA as follows:
        - (1) Connect the coax center conductor to test point A25TP3 (see Figure 3-1).
        - (2) Connect the coax ground (shield) to test point A25TP1.
    - (b) Connect the 67XXA rear panel PULSE SYNC OUTPUT to the Oscilloscope EXT TRIGGER IN.

3. On the 67XXA:
    - (a) Reconnect the line power cord.
    - (b) Press the LINE key to ON (ON indicator will light).

c. *Injection-Lock Adjustment*

1. Set up the Oscilloscope as follows:
   - (a) Vertical: 5V/div
   - (b) Horizontal: 5 µs/div
   - (c) Trigger: External

2. Set up the 67XXA as follows:
   - (a) Press INT PULSE.
   - (b) Press <Shift> INT WIDTH.
   - (c) Enter 10 µs.
   - (d) Press <Shift> INT RATE.
   - (e) Enter 50 kHz.

3. On the 67XXA, adjust A25R20 (see Figure 3-1) to provide a stable squarewave display on the Oscilloscope.

4. Rotate A25R20 slightly to each side of the setting that provides the stable squarewave display, carefully noting the adjustment positions at which the squarewave display becomes unstable.

5. Reset A25R20 exactly half-way between the positions at which the squarewave display becomes unstable.

6. Inscribe a mark on the potentiometer to show the position of this optimum setting.

7. On the 67XXA:
   - (a) Press the LINE key to STDBY (STDBY indicator will light).
   - (b) Disconnect the line power cord.
   - (c) Replace the cover on the A25 PCB housing.

3-10 ALC LEVEL OFFSET ADJUSTMENTS

a. Procedure Description

This procedure provides the steps necessary to perform the ALC Level Offset adjustment. This adjustment is required following replacement of the A15 ALC (Automatic Level Control) PCB. The adjustment sets the offset voltage to balance the ALC Band 0 and Band 1 to 5 Detector Preamplifiers.

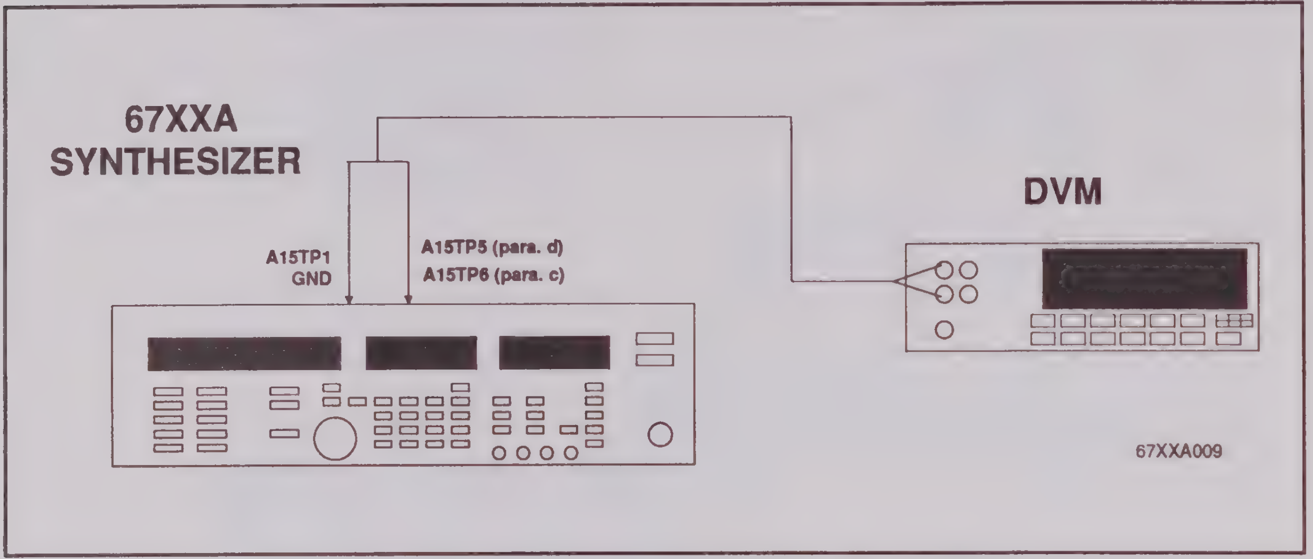

67XXA
SYNTHESIZER
DVM
A15TP1
GND
A15TP5 (para. d)
A15TP6 (para. c)
67XXA009

Figure 3-3. Test Equipment Setup for ALC Level Offset Adjustment

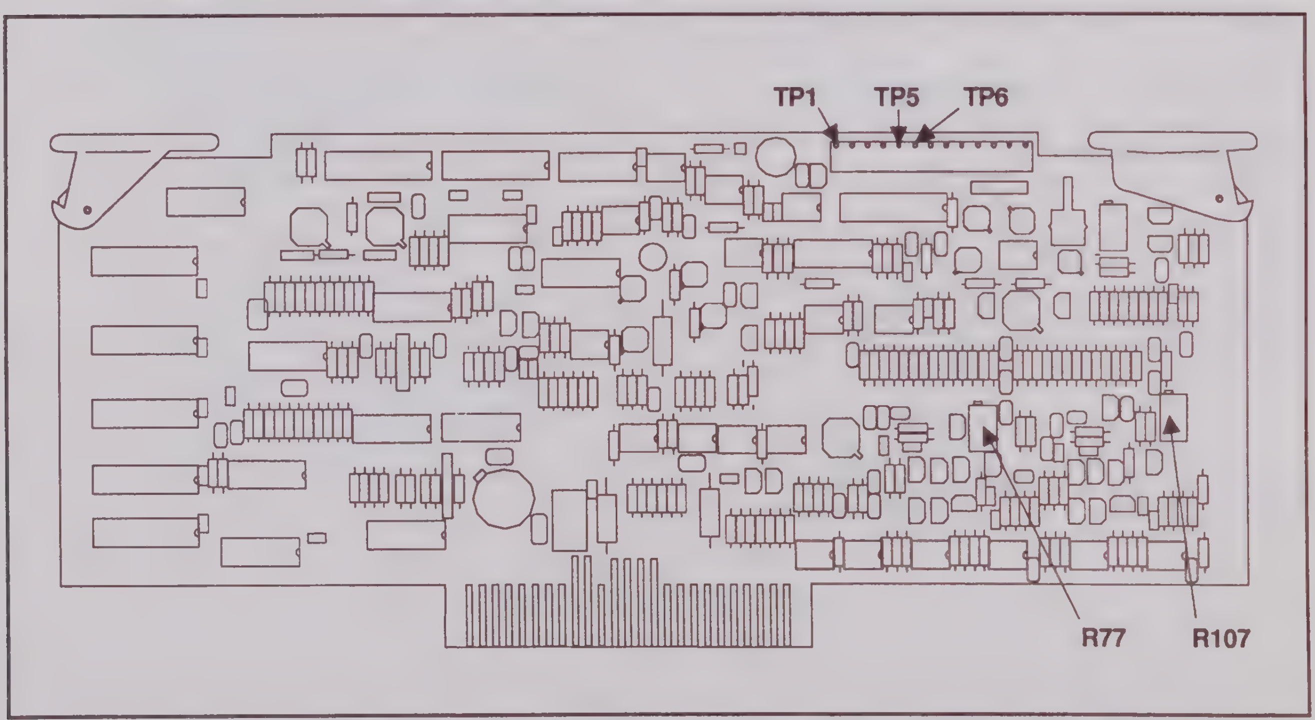

TP1
TP5
TP6
R77
R107

Figure 3-4. A15 ALC PCB Test Point and Adjustment Locations

b. Test Equipment Setup

1. Connect the equipment as shown in Figure 3-3 (see Figure 3-1 for test point locations).

c. Band 0 Level Offset Adjustment

NOTE

For 67XXA models without Band 0 (0.01 to 2 GHz), remove the cable from A28J12 and temporarily connect it to A28J13 (see Figure 3-1).

1. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) Press CW OUTPUT SELECT.
   - (c) Enter the frequency indicated on the Test Record.
   - (d) Press RF ON/OFF to turn the RF off (RF OFF indicator will light).

2. Set the Digital Voltmeter (DVM) to read dc voltage and connect as follows:
   - (a) Connect the DVM (+) lead to the 67XXA test point A15TP6 (see Figure 3-1).
   - (b) Connect the DVM (–) lead to the 67XXA test point A15TP1 (see Figure 3-1).

3. On the 67XXA A15 PCB, adjust A15R77 for 0 Vdc ±50 µVdc (see Figure 3-4). Record this voltage on the Test Record.

4. If the cable to A28J12 was connected to A28J13 for this adjustment, restore it to A28J12.

d. Band 1 to 5 Level Offset Adjustment

1. On the 67XXA:
   - (a) Press CW OUTPUT SELECT.
   - (b) Enter the frequency indicated on the Test Record.

2. Connect the DVM (+) lead to 67XXA test point A15TP5 (see Figure 3-1).

3. On the 67XXA A15PCB, adjust A15R107 for 0 Vdc ±50 µVdc (see Figure 3-4). Record this voltage on the Test Record.

3-11 EXTERNAL LEVELING OFFSET ADJUSTMENT

a. Procedure Description

This procedure provides the steps necessary to perform the External Leveling Offset adjustment. This adjustment is required following replacement of the A2 Front Panel PCB. The adjustment sets the offset voltage to balance the External Level Detector Amplifier.

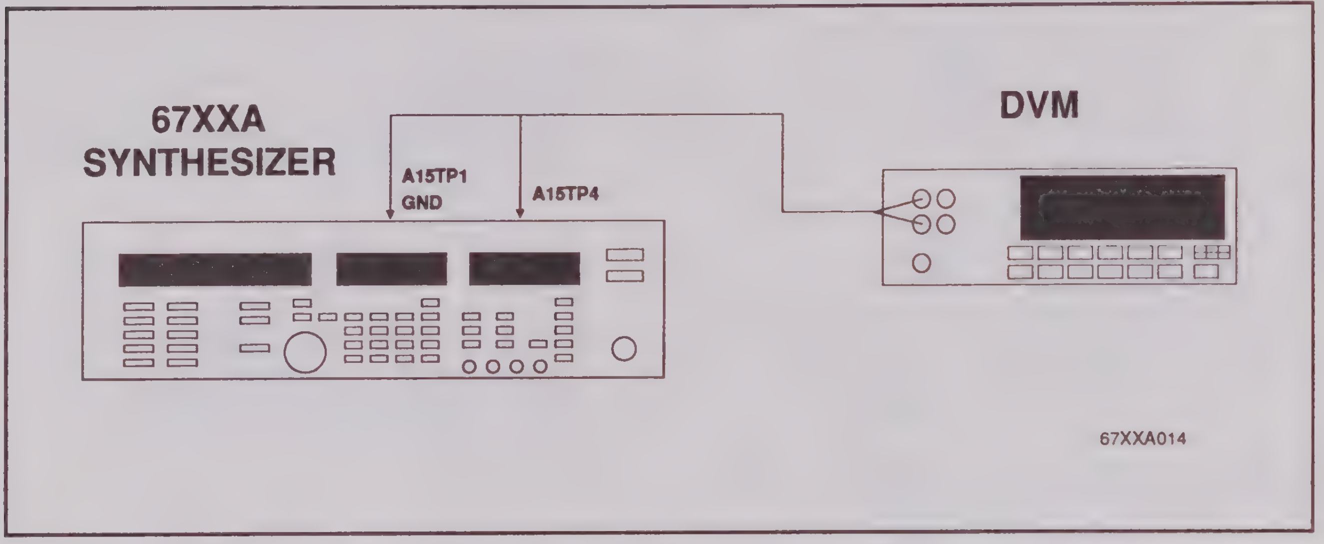


Figure 3-5. Test Equipment Setup for External Leveling Offset Adjustment

b. Test Equipment Setup.

1. Connect the equipment as shown in Figure 3-5 (see Figure 3-1 for test point location).

c. Leveling Offset Adjustment

1. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) Press the LEVELING key to light the EXT DETECTOR indicator.

2. Set the Digital Voltmeter (DVM) to read dc voltage and connect as follows:

3. Connect the DVM (+) lead to the 67XXA test point A15TP4 (see Figure 3-1).

4. Connect the DVM (–) lead to the 67XXA test point A15TP1 (see Figure 3-1).

5. On the 67XXA A2 PCB, adjust A2R15 for 0 Vdc ±1 mVdc (see Figure 3-1 for A2R15 location). Record this voltage on the Test Record.

3-12 10 MHz REFERENCE OSCILLATOR CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform the 10 MHz Reference Oscillator calibration. This calibration may be required at periodic intervals and following replacement of the 10 MHz Reference Oscillator.

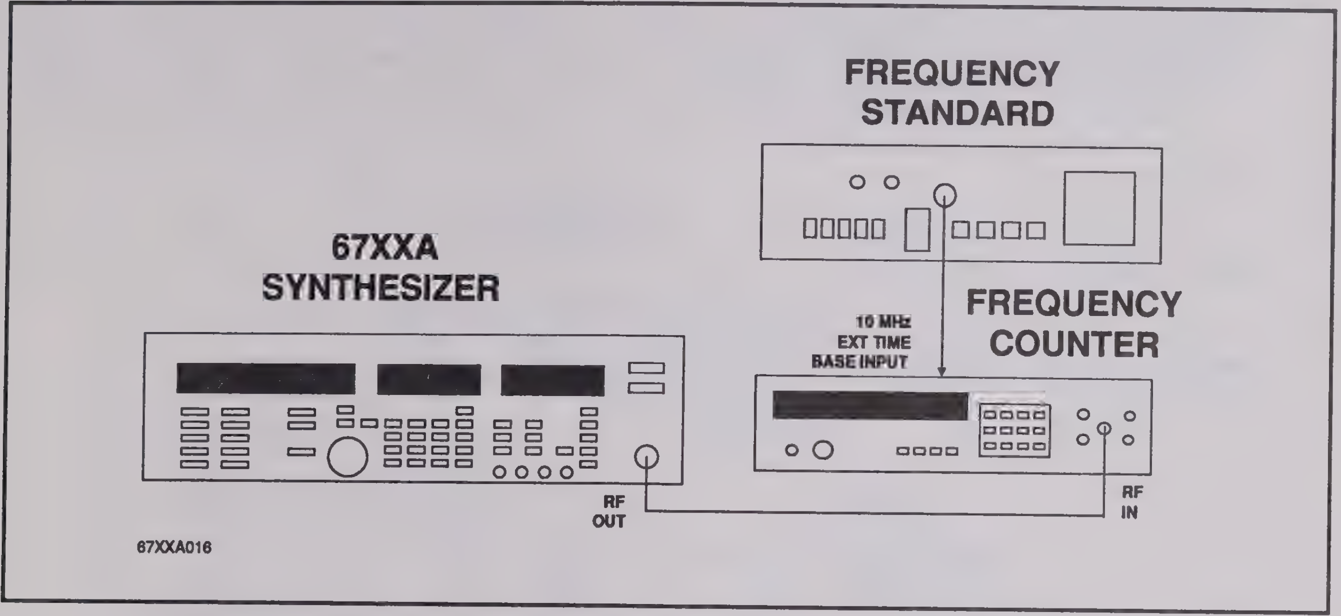


Figure 3-6. Test Equipment Setup for 10 MHz Reference Oscillator Calibration

b. Test Equipment Setup

1. Connect the equipment as shown in Figure 3-6.
   (a) Connect the 67XXA RF OUTPUT to the Frequency Counter RF Input.
   (b) Connect the Frequency Standard 10 MHz Output to the Frequency Counter 10 MHz External Time Base Input.

2. On the 67XXA, press the LINE key to STDBY (STDBY indicator will light). Allow the 67XXA to run in standby mode for 48 continuous hours.

3. Press the LINE key to ON two hours prior to calibration.

c. Reference Oscillator Calibration

1. Set up the 67XXA as follows:
   (a) Press <Shift> RESET.
   (b) Press CW OUTPUT SELECT.
   (c) Enter the frequency indicated on the Test Record.

2. Remove the adjustment-access screw from the top of the 10 MHz Reference Oscillator oven (see Figure 3-7).

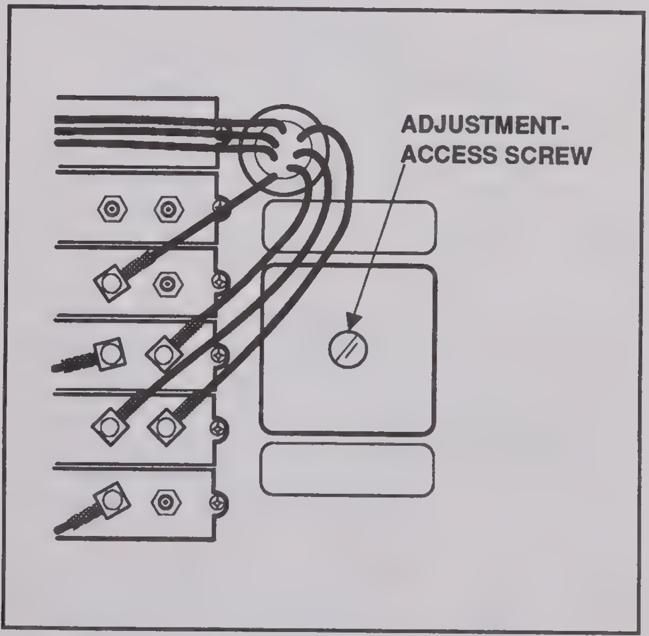


Figure 3-7. 10 MHz Reference Oscillator Oven Tuning Screw Location

3. Using a non-magnetic screwdriver, adjust the potentiometer located inside the oven housing to obtain a Frequency Counter reading equal to the frequency shown on the Test Record (to within ±100 Hz).

4. Using the handle of a screwdriver or similar device, tap the 10 MHz Reference Oscillator oven housing sharply while watching the frequency counter display for any variance. Readjust the potentiometer if necessary.

5. Repeat step c.4 as necessary to ensure frequency stability of the oscillator.

6. Replace the adjustment-access screw. This completes the 10 MHz Reference Oscillator calibration.

3-13 ALC BANDWIDTH CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform ALC Bandwidth calibration. This calibration may be required following replacement of either the A15 ALC PCB, the A29 Rear Panel Interface PCB, a YIG-tuned Oscillator, an Isolator, a Control Modulator, a Low Pass Filter, the 0.01 to 2 GHz Downconverter, the Switched Filter, the Frequency Doubler, a High Power Option RF Amplifier, the Main Multiplexer (PIN) Switch, the Leveling Detector/Directional Coupler, a Step Attenuator, or the A23U27 IC. The calibration determines the correct settings for the ALC Gain DAC and saves the values in EEPROM (A23U27). The ALC Gain DAC adjusts the overall ALC loop gain and bandwidth for each installed frequency band.

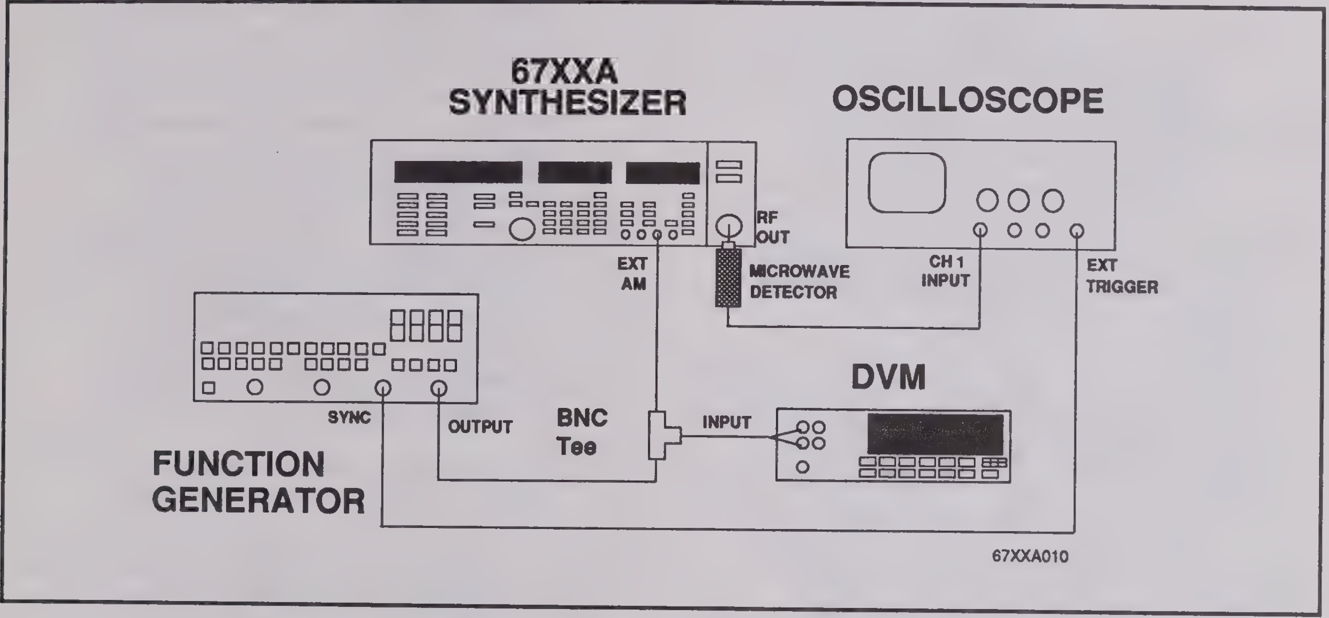


Figure 3-8. Test Equipment Setup for ALC Bandwidth Calibration

b. Test Equipment Setup

1. Connect the equipment as shown in Figure 3-8.
   - (a) Connect the Function Generator output to the BNC tee. Connect one leg of the tee to the 67XXA front panel EXT AM input. Connect the other leg of the tee to the DVM input.
   - (b) Connect the Function Generator SYNC output to the EXT TRIGGER input of the Oscilloscope.
   - (c) Connect the Microwave Detector output to the Vertical input (CH1) of the Oscilloscope.
   - (d) Connect the Microwave Detector input to the 67XXA RF OUTPUT.
   - (e) On the Oscilloscope, select 50Ω Input Impedance.

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

c. Bandwidth Calibration

1. Adjust the Function Generator for a sinewave output of 1 kHz, with an amplitude of 0.707 Vrms ± 0.5% and no dc offset. The generator voltage must be set while connected to the 67XXA EXT AM input through the BNC tee.

2. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) Set the output power to +2 dBm.

(c) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).
(d) Press CW OUTPUT SELECT.
(e) Enter the frequency indicated on the Test Record.
(f) Press AM.
(g) Press <Shift> TRIGGER 089, then <Shift> TRIGGER 402. This places the instrument in calibration mode.

NOTE

The calibration frequency is shown in the FREQUENCY display and the ALC gain DAC setting is shown in the MODULATION/TIME display.

3. On the Oscilloscope, adjust the vertical gain control for a vertical deflection of 6 major divisions.

4. On the Function Generator, adjust the output frequency to 30 kHz if calibrating bands 0 and 1 (frequencies 0.01 to 8 GHz) or 50 kHz if calibrating Bands 2 through 5 (frequencies 8 to 40 GHz).

5. On the Oscilloscope the vertical deflection should not be less than 4.2 divisions.

6. On the 67XXA, press SET INCR/DECR SIZE then enter 1 kHz.

7. While observing the Oscilloscope display, press the INCR or DECR keys to readjust the DAC for a vertical deflection of 6 major divisions.

8. On the 67XXA, press RECALL. The FREQUENCY display indication advances to the next calibration frequency.

9. Repeat steps c.7 and c.8 until the calibration frequency shown in the FREQUENCY display returns to the bottom frequency of the band.

10. On the 67XXA, press <Shift> to return from the calibration mode.

11. If the 67XXA instrument is a multiband unit, press CW OUTPUT SELECT, then enter the next frequency indicated on the Test Record. If the 67XXA instrument is a single band unit skip to step c.14.

12. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 402 to place the instrument in calibration mode.

13. Repeat steps c.3 through c.12 for each remaining band.

14. When all bands have been calibrated, press <Shift> to exit the calibration mode.

15. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 397. This generates new EEPROM checksums.

16. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the ALC Bandwidth calibration.

3-14 ANALOG SWEEP CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform Analog Sweep calibration. This calibration is required following replacement of either the A16 FM PCB, the A17 Analog Instruction PCB, or the A23U27 IC. The procedure calibrates the analog sweep times and analog sweep tuning ramps for all installed frequency bands and saves the calibration data in EEPROM (A23U27). Analog sweep time is controlled by the setting of the A17 Sweep Time DAC. The analog sweep tuning ramps are controlled by the settings of A17 Marker-Switch Point DAC, the A17 Sweep Width DAC, and the A17 Tune DAC.

b. Test Equipment Setup.

1. No test equipment is required for this calibration.

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

c. Sweep Calibration

1. Set up the 67XXA as follows:
    (a) Press <Shift> RESET.
    (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).
    (c) Press CW OUTPUT SELECT.
    (d) Enter the frequency indicated on the Test Record.
    (e) Press <Shift> TRIGGER 089, then <Shift> TRIGGER 403. This automatically calibrates the analog sweep time for the ≤1 second and the >1 second ranges.
    (f) Press <Shift> TRIGGER 405. This automatically calibrates the different paths used by the analog sweep.
    (g) Press <Shift> TRIGGER 406. This automatically calibrates the path used by narrow band sweeps (analog sweeps of ≤50 MHz).
    (h) Press <Shift> TRIGGER 397. This will generate new EEPROM checksums.

2. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the Analog Sweep calibration.

3-15 FM DRIVER CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform FM Driver calibration. This calibration is required following replacement of either the A16 FM PCB, any of the A18 thru A21 YIG Driver PCBs, any of the YIG-tuned Oscillators, or the A23U27 IC. The calibration determines the correct settings for the A16 FM Sensitivity Cal DAC for each installed YIG-tuned Oscillator and saves the values in EEPROM (A23U27). The A16 FM Sensitivity Cal DAC compensates for variations in YIG-tuned Oscillator sensitivities and YIG loop components by setting a YIG driver sensitivity of 5 MHz/V for each installed YIG-tuned Oscillator. This results in a more constant YIG loop gain.

b. Test Equipment Setup

1. No test equipment is required for this calibration.

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

c. FM Driver Calibration

1. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper in the CAL position (see Figure 3-1).
   - (c) Press CW OUTPUT SELECT.
   - (d) Enter the frequency indicated on the Test Record.
   - (e) Press <Shift> TRIGGER 089, then <Shift> TRIGGER 404. The automatic calibration process takes approximately 15 seconds to complete.
   - (f) Press <Shift> TRIGGER 397. This will generate new EEPROM checksums.

2. This completes the FM Driver calibration. Restore the A23 PCB CAL/NORM jumper to the NORM position.

3-16 YIG-TUNED OSCILLATOR FREQUENCY CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform YIG-tuned Oscillator Frequency calibration. This calibration is required following the replacement of either the A16 FM PCB, the A17 Analog Instruction PCB, any of the A18 thru A21 YIG Driver PCBs, any of the YIG-tuned Oscillators, or the A23U27 IC. The procedure determines the correct settings for the A17 Tune DAC and the A17 Linearizer DAC for each installed frequency band and stores the calibration data in EEPROM (A23U27). The A17 Tune DAC and the A17 Linearizer DAC adjust the YIG-tuned Oscillators for an accurate, linear frequency output (to within ±2 MHz) throughout the range of each installed frequency band.

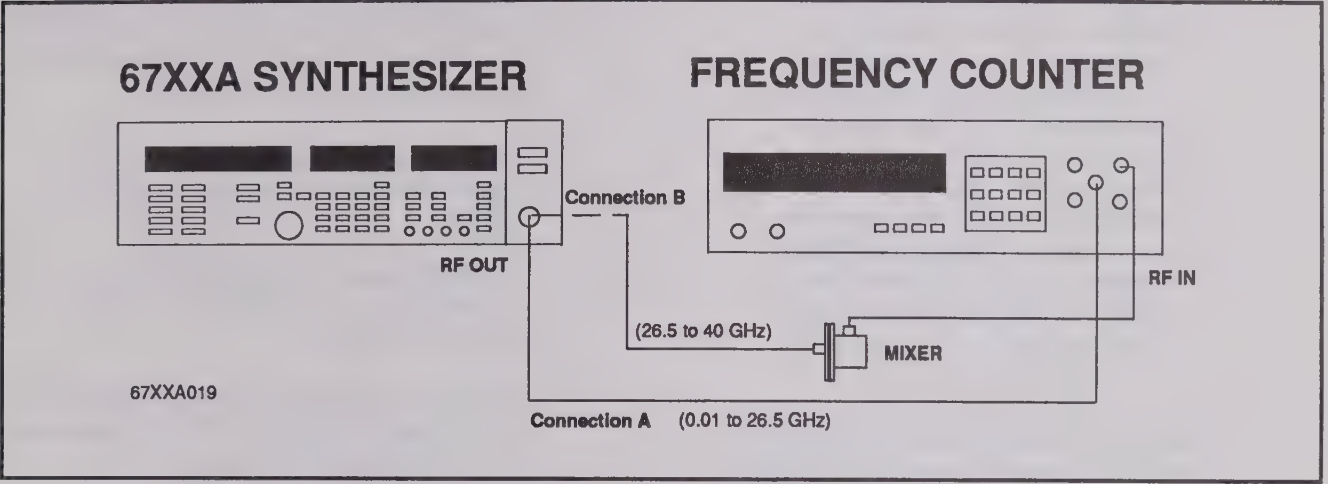


Figure 3-9. Test Equipment Setup for YIG Oscillator Frequency Calibration

b. Test Equipment Setup

1. Connect the equipment as shown in Figure 3-9.
   (a) Connect the 67XXA RF OUTPUT to the Frequency Counter RF Input.

NOTE

For measuring frequencies in the range of 0.01 to 26.5 GHz, connect the 67XXA RF OUT to the Frequency Counter RF IN as shown in Connection A. For measuring frequencies in the range of 26.5 to 40 GHz, connect the 67XXA RF OUT to the Frequency Counter RF IN as shown in Connection B using the Option 91 waveguide mixer.

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

c. Frequency Calibration

1. Set up the 67XXA as follows:
   (a) Press <Shift> RESET.
   (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).
   (c) If the A23U27 EEPROM was replaced, press <Shift> TRIGGER 089, then <Shift> TRIGGER 390 to erase any previous A17 Linearizer DAC calibration data.
   (d) Press CW OUTPUT SELECT.
   (e) Enter the frequency indicated on the Test Record.
   (f) Press <Shift> TRIGGER 089, then <Shift> TRIGGER 460.

   (g) Press SET INCR/DECR SIZE.
   (h) Enter 1 MHz.

2. Observe the frequency displayed on the Frequency Counter. Using the 67XXA INCR and DECR keys, adjust the counter frequency to agree with the 67XXA FREQUENCY display to within ±2 MHz.

   NOTE

   If the counter frequency differs greatly from the 67XXA frequency (or if you have difficulty in making the two frequencies match), you may wish to select a larger incremental MHz value for the SET INCR/DECR SIZE step size. As the counter frequency gets closer to the 67XXA frequency, select a smaller incremental MHz value for the SET INCR/DECR SIZE step size.

3. When the counter frequency agrees with the 67XXA frequency to within ±2 MHz, press RECALL. This saves the calibration data and sets the 67XXA to the next frequency to be calibrated in the band.

4. Repeat steps c.2 and c.3 for the remaining frequencies to be calibrated in the band.

5. When all frequencies in the band have been calibrated, record on the Test Record the maximum difference between the counter frequency and the 67XXA frequency for the band being calibrated (should not exceed ±2 MHz). On the 67XXA, press <Shift>. This gets you out of the band you have been calibrating.

6. If the 67XXA instrument is a multi-band unit, press CW OUTPUT SELECT, then enter the next frequency indicated on the Test Record. If the 67XXA instrument is a single-band unit skip to step c.8.

7. Repeat steps c.1(f) through c.6 for the remaining bands appearing in the Test Record.

8. When all bands have been calibrated, press <Shift> twice, then RESET to exit the calibration mode.

9. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 397. This generates new EEPROM checksums.

10. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the YIG-tuned Oscillator Frequency calibration.

3-17 RF LEVEL CALIBRATION

a. Procedure Description

RF level calibration requires the use of an automated test system. A computer-controlled power meter measures 67XXA power output at many frequencies and power levels for each installed frequency band. Correction factors are then calculated and stored in EEPROM (A23U27 or A23U28).

This calibration is required following replacement of either the A15 ALC PCB, the 0.01 to 2 GHz Downconverter, the Leveling Detector/Directional Coupler, a Step Attenuator, or the A23U27 or A23U28 ICs.

For information concerning test equipment requirements and ordering the automated program contact WILTRON Customer Service department at (408) 778-2000.

3-18 ALC SLOPE CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform the ALC Slope calibration. This calibration is required following replacement of either the A15 ALC PCB, the A29 Rear Panel Interface PCB, the 0.01 to 2 GHz Downconverter, the Leveling Detector/Directional Coupler, a Step Attenuator, or the A23U27 IC. This calibration determines the correct settings for the ALC Slope DAC and saves the values in EEPROM (A23U27). During the analog sweep mode, the ALC Slope DAC adjusts for an increasing or decreasing output power-vs.-output frequency. The ALC Slope DAC has two settings; one for ≤2 GHz, and one for >2 GHz.

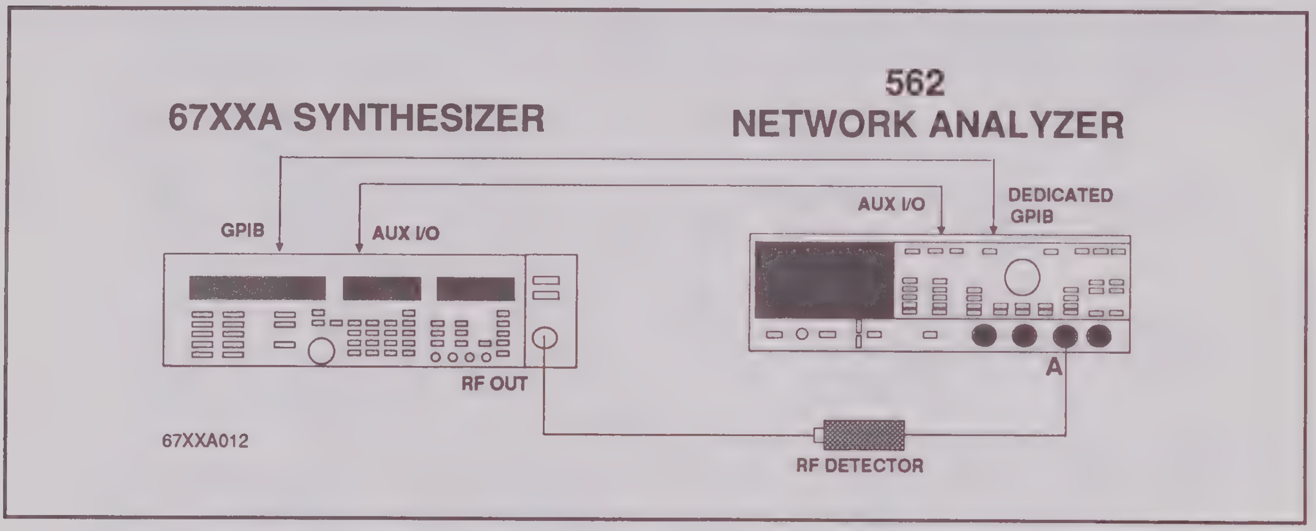


Figure 3-10. Test Equipment Setup for ALC Slope Calibration

b. Test Equipment Setup

1. Connect the equipment as shown in Figure 3-10.
   (a) Calibrate the 562 Network Analyzer with the appropriate RF Detector.
   (b) Connect the 67XXA rear panel AUX I/O to the 562 Network Analyzer AUX I/O.
   (c) Connect the 562 Network Analyzer DEDICATED GPIB to the 67XXA rear panel GPIB.
   (d) Connect the RF Detector to the 562 Network Analyzer Channal A Input.
   (e) Connect the 67XXA RF OUTPUT to the RF Detector Input.

NOTE

For 67XXA models 6717A/-20, 6722A/-20, 6747A/-20, 6759A/-10, and 6769A, the ALC Slope calibration must be performed twice – once for the≤2 GHz Level Detector circuitry and once for the >2 GHz Level Detector circuitry. The individual Test Record will indicate the appropriate F1 and F2 frequencies to be entered and the correct <Shift> TRIGGER code to be used.

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

c. *Slope Calibration*

1. Set up the 562 Network Analyzer as follows:
   - (a) Press the SYSTEM MENU key.
   - (b) From the System Menu display, select RESET. This resets both the 562 and the 67XXA.
   - (c) Press CHANNEL 2 DISPLAY: OFF
   - (d) Press CHANNEL 1 DISPLAY: ON
   - (e) Press CHANNEL 1 MENU key.
   - (f) From the Channel 1 Menu display, select POWER.

2. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).
   - (c) On the rear panel, set the FUNCTION SELECT V/GHz to 0.5 V/GHz.
   - (d) Press F1-F9 SCAN ▲ to light the F1 annunciator.
   - (e) Enter the frequency indicated on the Test Record for F1.
   - (f) Press F1-F9 SCAN ▲ to light the F2 annunciator.
   - (g) Enter the frequency indicated on the Test Record for F2.
   - (h) Press F1–F2 to start an analog sweep.
   - (i) Press <Shift> TRIGGER 089, then <Shift> TRIGGER 050 (for ≤.2 GHz) or <Shift> TRIGGER 051 (for >2 GHz).
   - (j) Press INT PULSE.
   - (k) Enter 9 kHz.
   - (l) Press CW OUTPUT SELECT.
   - (m) Enter 128 MHz.
   - (n) Press SET INCR/DECR SIZE
   - (o) Enter 10 MHz.

3. On the 562 Network Analyzer, observe that the waveform displayed is similar to that shown in Figure 3-11.

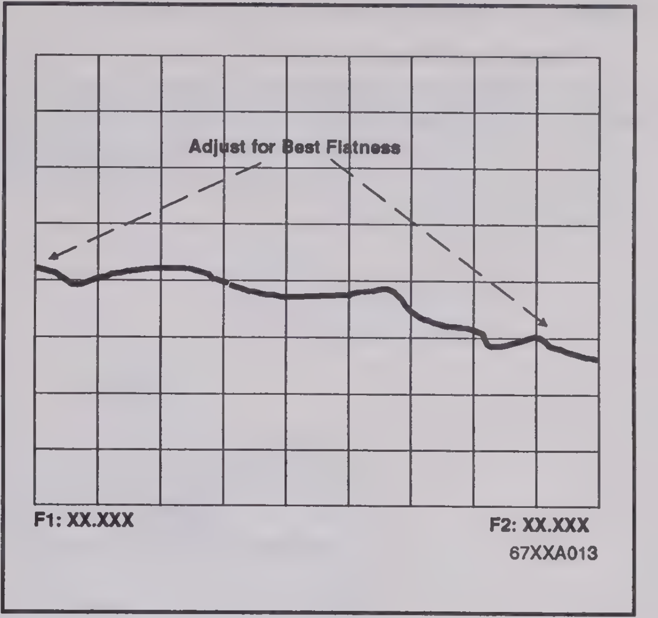


Figure 3-11. Level Detector Waveform

4. While observing the 562 Network Analyzer display, press the 67XXA DECR and INCR keys to adjust the displayed waveform for best flatness.

5. On the 67XXA, press RECALL to save the calibration value. Record the waveform on the Test Record.

6. If the Test Record calls for a second ALC Slope calibration, repeat steps c.2 through c.5 using the F1 and F2 frequencies and the <Shift> TRIGGER code indicated on the Test Record. When completed proceed to step c.7.

7. On the 67XXA, press <Shift> RESET to exit the calibration mode.

8. Press <Shift> TRIGGER 089, then <Shift> TRIGGER 397 to generate new EEPROM checksums.

9. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the ALC Slope calibration.

3-19 AM SENSITIVITY CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform AM Sensitivity calibration. This calibration is required following replacement of either the A15 ALC PCB or the A23U27 IC. The calibration procedure determines the correct setting of the A15 %AM DAC for each installed frequency band and stores the calibration data in EEPROM (A23U27). The %AM DAC sets the %AM-per-volt sensitivity of the external AM input for each installed frequency band.

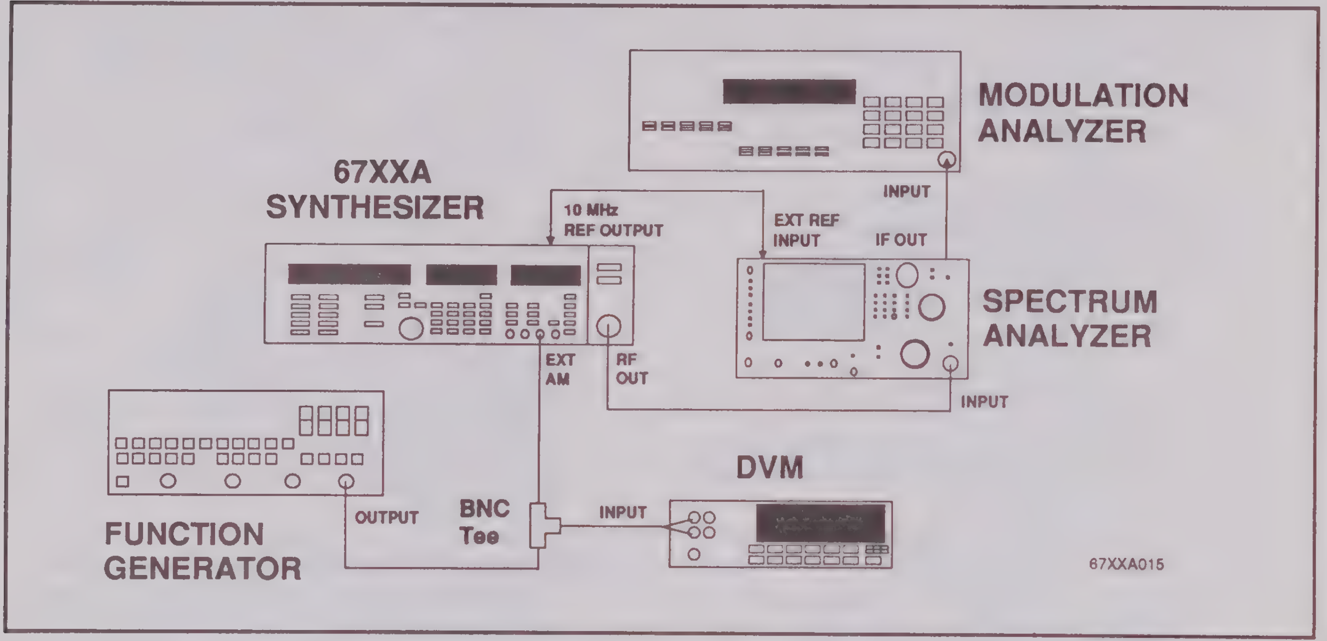


Figure 3-12. Test Equipment Setup for AM Sensitivity Calibration (0.01 to 20 GHz)

b. Test Equipment Setup (for frequencies 0.01 to 20 GHz)

1. Connect the equipment as shown in Figure 3-12.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the Function Generator Output to the BNC tee. Connect one leg of the tee to the 67XXA front panel EXT AM input. Connect the other leg of the tee to the DVM input.
   - (c) Connect the IF Output of the Spectrum Analyzer to the RF Input of the Modulation Analyzer.
   - (d) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

c. Test Equipment Setup (for frequencies 20 to 40 GHz)

1. Connect the equipment as shown in Figure 3-13 (see following page).
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the Function Generator Output to the BNC tee. Connect one leg of the tee to the 67XXA front panel EXT AM input. Connect the other leg of the tee to the DVM input.
   - (c) Connect the IF Output of the Spectrum Analyzer to the RF Input of the Modulation Analyzer.
   - (d) Connect the Diplexer and the appropriate external Waveguide Mixer to the Spectrum Analyzer.
   - (e) Connect the 67XXA RF OUTPUT to the Waveguide Mixer input.

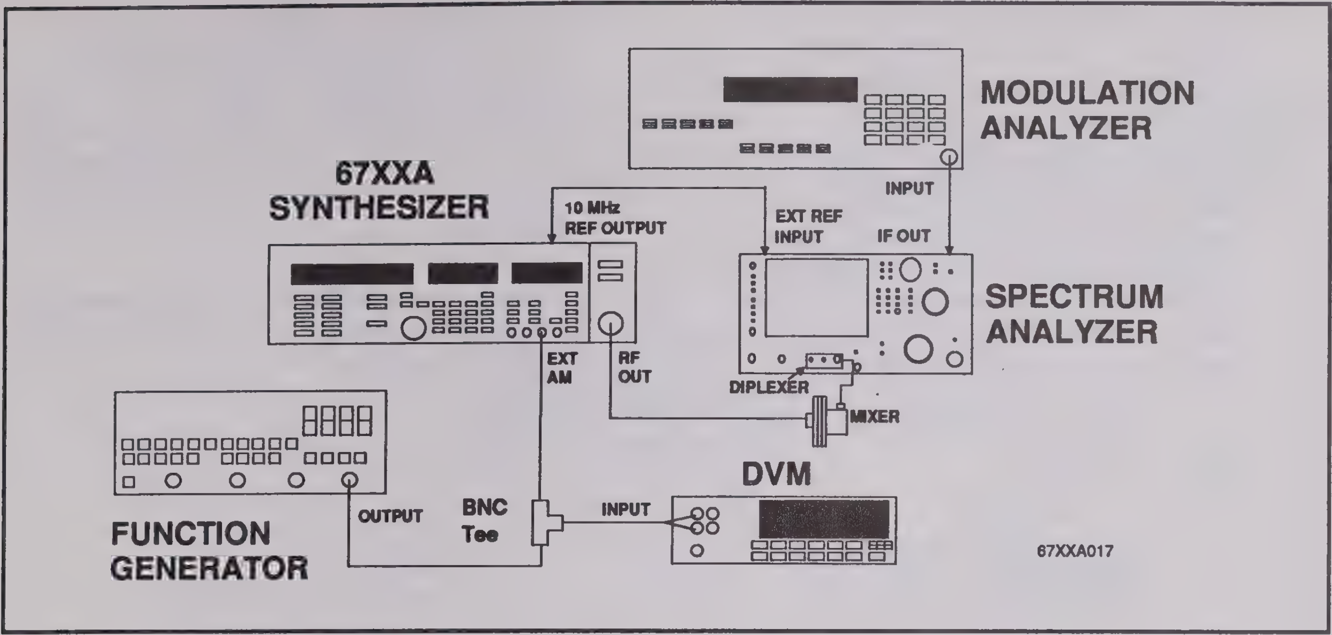

MODULATION ANALYZER
67XXA SYNTHESIZER
INPUT
10 MHz REF OUTPUT
EXT REF INPUT
IF OUT
SPECTRUM ANALYZER
EXT AM
RF OUT
DIPLEXER
MIXER
DVM
OUTPUT
BNC Tee
INPUT
FUNCTION GENERATOR
67XXA017

Figure 3-13. Test Equipment Setup for AM Sensitivity Calibration (20 to 40 GHz)

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

d. AM Sensitivity Calibration

1. Adjust the Function Generator for a sinewave output of 1 kHz, with an amplitude of 0.707 Vrms ±0.5% and no dc offset. The generator voltage must be set while connected to the 67XXA EXT AM input through the BNC tee.

2. Set up the 67XXA as follows:
   (a) Press <Shift> RESET.
   (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).
   (c) Press CW OUTPUT SELECT.
   (d) Enter the frequency noted on the Test Record.
   (e) Press LEVEL 1.
   (f) Enter a power level that is 3 dB below maximum rated output power.

3. Set up the Spectrum Analyzer as follows:
   (a) CF: Same as 67XXA frequency set in step d.2(d)
   (b) Span/Div: 0 Hz (labeled as 10 mSec setting on Tektronix Model 494)
   (c) Resolution BW: 100 kHz
   (d) MIN Noise: Activated

4. On the Spectrum Analyzer, locate the fundamental frequency and adjust to place the peak of the fundamental at the top most graticule line. Adjust the reference level to place the signal 10 dB below the top graticule line.

5. Set up the Modulation Analyzer for:
   (a) MEASURE AM
   (b) 300 Hz High-Pass Filter
   (c) 3 kHz Low-Pass Filter

6. On 67XXA;
   (a) Press AM.
   (b) Press <Shift> AM SENS.
   (c) Enter 50%.
   (d) Press <Shift> TRIGGER 089, then <Shift> TRIGGER 306.
   (e) Press CW OUTPUT SELECT.
   (f) Enter 100 MHz.
   (g) Press SET INCR/DECR SIZE.
   (h) Enter 1 MHz.

7. While observing the %AM display on the Modulation Analyzer, press the 67XXA DECR and INCR keys to obtain an AM reading of 50% ± 3%.

8. On the Modulation Analyzer, press AM PK(+) and record the reading on the Test Record. Press AM PK(–) and record the reading on the Test Record. Average the AM PK(+) and AM PK(–) readings together and record the result on the Test Record. The average should be >47.0% and <53.0%.

9. On the 67XXA, press RECALL to save the calibration results.

10. If the 67XXA instrument is a multiband unit, repeat steps d.2 thru d.9 for each of the remaining bands. If the 67XXA is a single band unit, go to step d.11.

11. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 397 to generate new EEPROM checksums.

12. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the AM Sensitivity calibration.

3-20 AM METER CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform AM Meter calibration. This calibration is required following replacement of either the A15 ALC PCB or the A23U27 IC. The procedure calibrates the metering function of the AM circuitry (% AM readout on the MODULATION display) and stores the calibration data in EEPROM (A23U27).

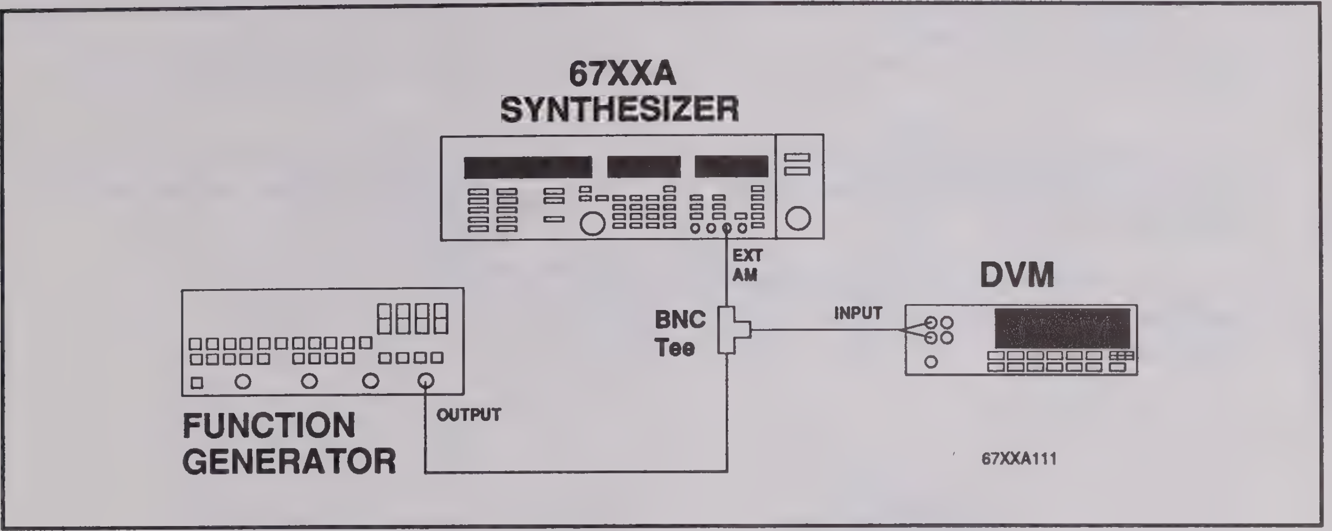


Figure 3-14. Test Equipment Setup for AM Meter Calibration

b. Test Equipment Setup

1. Connect the equipment as was shown in Figure 3-14.
    - (a) Connect the Function Generator output to the BNC tee.
    - (b) Connect one leg of the tee to the 67XXA front panel EXT AM input.
    - (c) Connect the other leg of the tee to the DVM input.

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

c. AM Meter Calibration

1. Adjust the Function Generator for a sinewave output of 1 kHz, with an amplitude of 0.707 Vrms ±0.5% and no dc offset. The generator voltage must be set while connected to the 67XXA EXT AM input through the BNC tee.

2. Set up the 67XXA as follows:
    - (a) Press <Shift> RESET.
    - (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).
    - (c) Press CW OUTPUT SELECT.
    - (d) Enter the frequency noted on the Test Record.
    - (e) Press AM.

3. Disconnect the Function Generator from the 67XXA EXT AM input.

4. On the 67XXA, press <Shift > TRIGGER 089, then <Shift> TRIGGER 398. This zeros the AM meter calibration data.

5. On the 67XXA, press <Shift> TRIGGER 342. This calibrates the AM meter when there is no input voltage.

6. Reconnect the Function Generator to the 67XXA EXT AM input.

7. On the 67XXA, press <Shift> TRIGGER 343. This calibrates the AM meter to a .707 Vrms input and saves the calibration data.

8. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 397 to generate new EEPROM checksums.

9. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the AM Meter calibration.

d. AM Meter Calibration Verification

1. To verify the previous AM Meter calibration, perform the following procedure.

2. On the 67XXA:
   (a) Press <Shift> RESET.
   (b) Press CW OUTPUT SELECT.
   (c) Enter the frequency indicated on the Test Record.
   (d) Press <Shift> AM SENSE then enter 50%.
   (e) Press AM.
   (f) Press MEASURE AM DEPTH. The display should indicate >47.5% and <52.5%.

3-21 FM SENSITIVITY CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform FM Sensitivity calibration. This calibration is required following replacement of either the A16 FM PCB, any of the A18 thru A21 YIG Driver PCBs, any of the YIG-tuned Oscillators, or the A23U27 IC. The calibration procedure determines the correct setting of the A16 FM Attn DAC for each installed frequency band and stores the calibration data in EEPROM (A23U27). The FM Attn DAC sets the MHz/kHz-per-volt sensitivity of the external FM input for each installed frequency band.

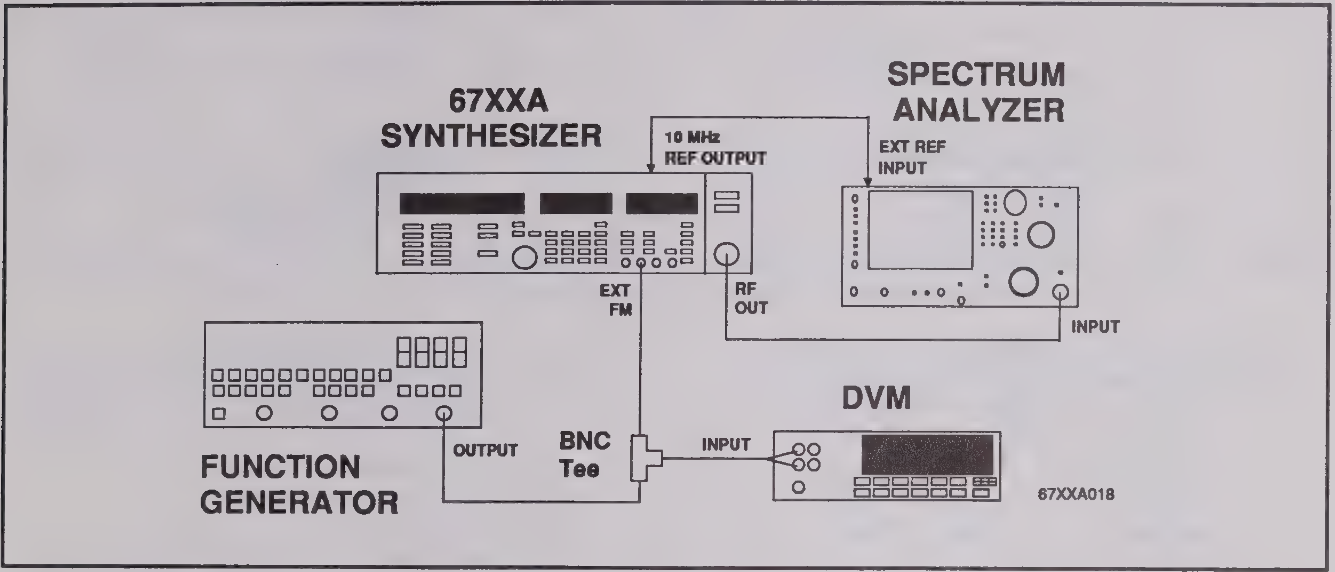


Figure 3-15. Test Equipment Setup for FM Sensitivity Calibration (0.01 to 20 GHz)

b. Test Equipment Setup (for frequencies 0.01 to 20 GHz)

1. Connect the equipment as shown in Figure 3-15.
    - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
    - (b) Connect the Function Generator Output to the BNC tee.
    - (c) Connect one leg of the tee to the 67XXA front panel EXT FM input.
    - (d) Connect the other leg of the tee to the DVM input.
    - (e) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

c. Test Equipment Setup (for frequencies 20 to 40 GHz)

1. Connect the equipment as shown in Figure 3-16 (see following page).
    - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
    - (b) Connect the Function Generator Output to the BNC tee.
    - (c) Connect one leg of the tee to the 67XXA front panel EXT FM input.
    - (d) Connect the other leg of the tee to the DVM input.
    - (e) Connect the Diplexer and the appropriate external Waveguide Mixer to the Spectrum Analyzer.
    - (f) Connect the 67XXA RF OUTPUT to the Waveguide Mixer input.

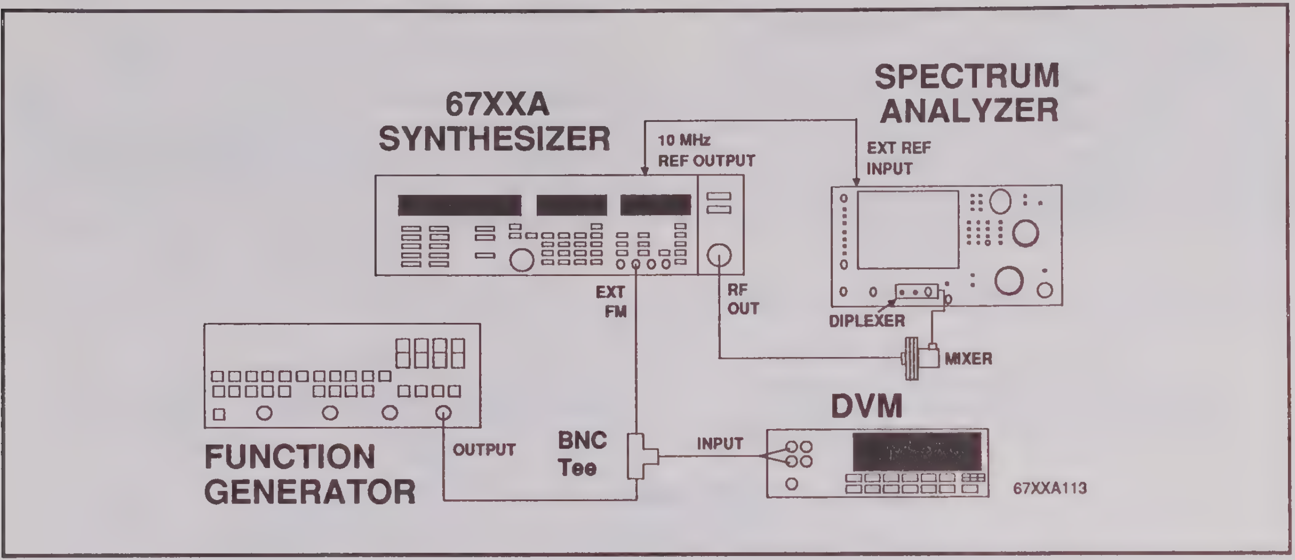


Figure 3-16. Test Equipment Setup for FM Sensitivity Calibration (20 to 40 GHz)

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

d. *FM Sensitivity Calibration*

1. Adjust the Function Generator for a sinewave output of 40 kHz ±200 Hz with an amplitude of 0.707 Vrms ±0.5% and no dc offset. The generator voltage must be set while connected to the 67XXA EXT FM input through the BNC tee.

2. Set up the 67XXA as follows:
   (a) Press <Shift> RESET.
   (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).
   (c) Press CW OUTPUT SELECT.
   (d) Enter the frequency indicated on the Test Record.

3. Set the Spectrum Analyzer as follows:
   (a) CF: Same as the 67XXA CW frequency set in step d.2(d)
   (b) Span/Div: 10 kHz
   (c) RBW: 1 kHz
   (d) Filter: Wide
   (e) Ref Level: Adjust to place the signal peak at the top graticule of the display (with 67XXA FM off)

4. On the 67XXA;
   (a) Press <Shift> FM SENS.
   (b) Enter 96 kHz.
   (c) Press FM.
   (d) Press <Shift> TRIGGER 089, then press <Shift> TRIGGER 308.
   (e) Press CW OUTPUT SELECT.
   (f) Enter 2300 MHz (if calibrating frequency band 26.5 to 40 GHz, enter 1200 MHz).
   (g) Press SET INCR/DECR SIZE.
   (h) Enter 100 MHz.

5. While observing the Spectrum Analyzer display, press the 67XXA DECR and INCR keys to adjust the waveform displayed so that the center portion (Bessel null) is at minimum amplitude (see Figure 3-17).

6. On the 67XXA, press SET INCR/DECR SIZE and enter a step size of 10 MHz.

7. Using the 67XXA DECR and INCR keys, fine-adjust the Bessel null to at least 40 dB below the top graticule (if necessary, change the step size to 1 MHz).

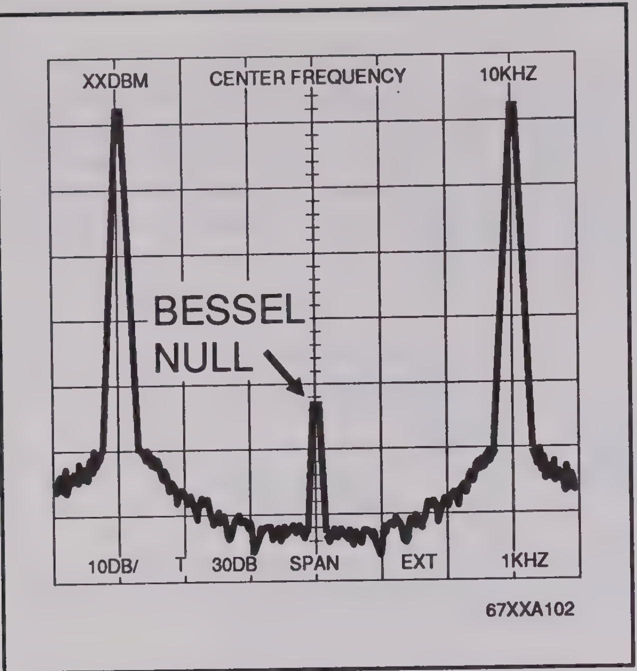


Figure 3-17. Typical Spectrum Analyzer Display of Bessel Null on FM Modulation Waveform

8. On the 67XXA, press RECALL to store the calibration data. Record the waveform on the Test Record.

9. If the 67XXA instrument is a multiband unit, press CW OUTPUT SELECT, then enter the next frequency indicated on the Test Record. If the 67XXA instrument is a single-band unit skip to step d.11.

10. Repeat steps d.3 through d.9 for the remaining band(s) to be calibrated.

11. When all bands have been calibrated, press <Shift> to exit the calibration mode.

12. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 397 to generate new EEPROM checksums.

13. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the FM Sensitivity calibration.

3-22 FM FLATNESS CALIBRATION

a. *Procedure Description*

This procedure provides the steps necessary to perform FM Flatness calibration. This calibration is required following replacement of either the A12 YIG Phase Detector PCB, the A16 FM PCB, any of the A18 thru A21 YIG Driver PCBs, any of the YIG-tuned Oscillators, or the A23U27 IC. The calibration procedure determines the correct setting of the A16 Phase Mod Cal DAC for each installed frequency band and stores the calibration data in EEPROM (A23U27). The Phase Mod Cal DAC sets the flatness of the FM circuit response by adjusting the FM deviation in the phase-lock mode.

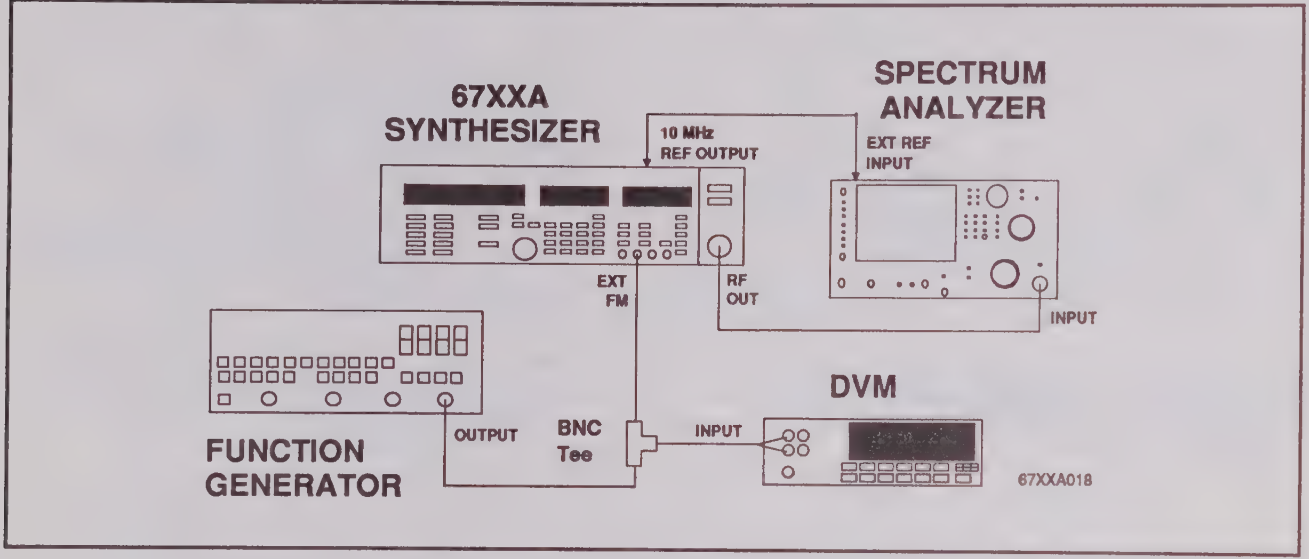


Figure 3-18. Test Equipment Setup for FM Flatness Calibration (0.01 to 20 GHz)

b. *Test Equipment Setup (for frequencies 0.01 to 20 GHz)*

1. Connect the equipment as was shown in Figure 3-18.
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the Function Generator Output to the BNC tee.
   - (c) Connect one leg of the tee to the 67XXA front panel EXT FM input.
   - (d) Connect ther other leg of the tee to the DVM input.
   - (e) Connect the 67XXA RF OUTPUT to the Spectrum Analyzer RF Input.

c. *Test Equipment Setup (for frequencies 20 to 40 GHz)*

1. Connect the equipment as shown in Figure 3-19 (see following page).
   - (a) Connect the 67XXA rear panel 10 MHZ REF OUTPUT to the Spectrum Analyzer External Reference Input.
   - (b) Connect the Function Generator Output to the BNC tee.
   - (c) Connect one leg of the tee to the 67XXA front panel EXT FM input.
   - (d) Connect the other leg of the tee to the DVM input.
   - (e) Connect the Diplexer and the appropriate external Waveguide Mixer to the Spectrum Analyzer.
   - (f) Connect the 67XXA RF OUTPUT to the Waveguide Mixer.

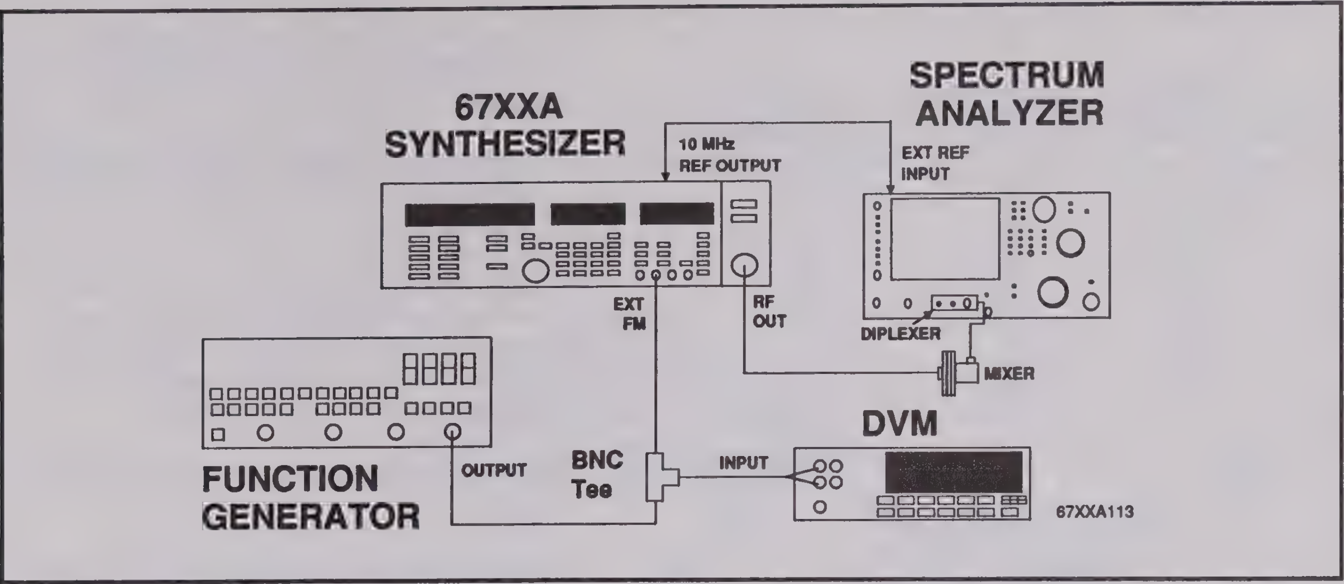


Figure 3-19. Test Equipment Setup for FM Flatness Calibration (20 to 40 GHz)

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

d. FM Flatness Calibration

1. Adjust the Function Generator for a sinewave output of 2 kHz ±10 Hz , with an amplitude of 0.339 Vrms ±0.003 Vrms and no dc offset. The generator voltage must be set while connnected to the 67XXA EXT FM input through the BNC tee.

2. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper in the CAL position (see Figure 3-1).
   - (c) Press CW OUTPUT SELECT.
   - (d) Enter the frequency indicated on the Test Record.

3. Set the Spectrum Analyzer as follows:
   - (a) CF: Same as the 67XXA CW frequency set in step d.2(d)
   - (b) Span/Div: 1 kHz
   - (c) RBW: 1 kHz
   - (d) Ref Level: Adjust to place the signal peak at the top graticule of the display (with 67XXA FM off)

4. On the 67XXA;
   - (a) Press <Shift> FM SENS.
   - (b) Enter 10 kHz.
   - (c) Press FM.

5. On the Spectrum Analyzer, observe that the fundamental has dropped in amplitude and has 2 kHz sidebands (see Figure 3-20).

6. On the 67XXA;
   - (a) Press <Shift> TRIGGER 089, then <Shift> TRIGGER 317.
   - (b) Press CW.
   - (c) Enter 80 MHz.
   - (d) Press SET INCR/DECR SIZE.
   - (e) Enter 10 MHz.

7. While observing the Spectrum Analyzer display, press the 67XXA DECR and INCR keys to adjust the fundamental as far as possible down from the reference established in step d.3(d).

8. On the 67XXA, press SET INCR/DECR SIZE and enter a step size of 1 MHz.

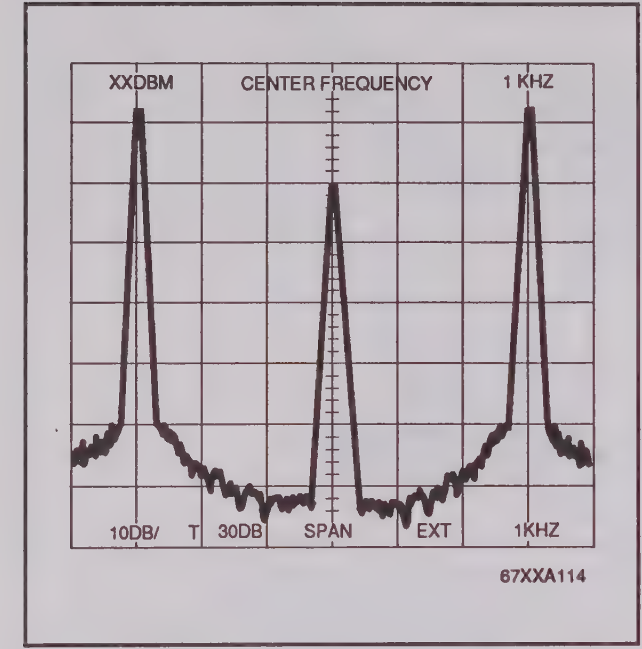


Figure 3-20. Typical Spectrum Analyzer Display of FM Flatness Response

9. Using the 67XXA DECR and INCR keys, fine adjust to set the fundamental level to at least 10 dB below the top graticule.

10. On the 67XXA, press RECALL to store the calibration data. Record the waveform on the Test Record..

11. If the 67XXA instrument is a multiband unit, press CW OUTPUT SELECT, then enter the next frequency indicated on the Test Record. If the 67XXA instrument is a single band unit skip to step d.12.

12. Repeat steps d.3 thru d.11 for the remaining band(s) to be calibrated.

13. When all bands have been calibrated, press <Shift> to exit the calibration mode.

14. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 397 to generate new EEPROM checksums.

15. Restore the A23 PCB CAL/NORM jumper to the NORM position. This completes the FM Flatness calibration.

3-23 FM METER CALIBRATION

a. Procedure Description

This procedure provides the steps necessary to perform FM Meter calibration. This calibration is required following replacement of the A16 FM PCB or the A23U27 IC. The procedure calibrates the metering function of the FM circuitry (FM MHz/V or FM KHz/V readout on the MODULATION display) and stores the calibration data in EEPROM (A23U27).

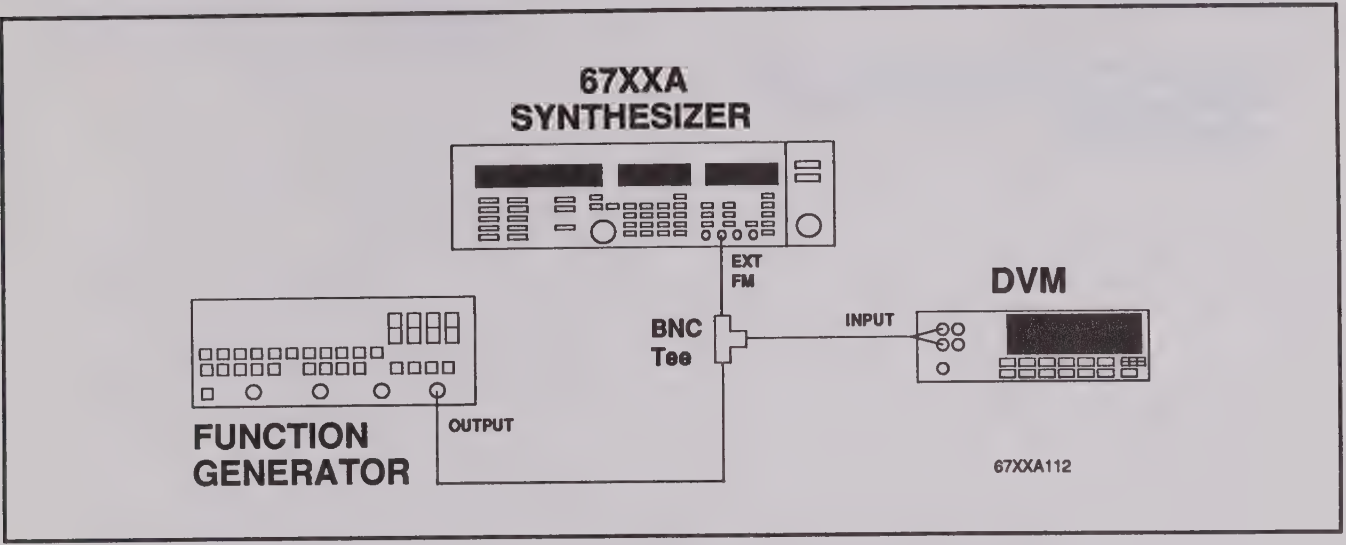


Figure 3-21. Test Equipment Setup for FM Meter Calibration

b. Test Equipment Setup

1. Connect the equipment as was shown in Figure 3-21.
   - (a) Connect the Function Generator output to the BNC tee.
   - (b) Connect one leg of the tee to the 67XXA front panel EXT FM input.
   - (c) Connect the other leg of the tee to the DVM input.

CAUTION

Care must be exercised when entering <Shift> TRIGGER codes during calibration procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

c. FM Meter Calibration

1. Adjust the Function Generator for a sinewave output of 40 kHz, with an amplitude of 0.707 Vrms ±0.5% and no dc offset. The generator voltage must be set while connected to the 67XXA EXT FM input through the BNC tee.

2. Set up the 67XXA as follows:
   - (a) Press <Shift> RESET.
   - (b) On the A23 Microprocessor PCB, move the CAL/NORM jumper to the CAL position (see Figure 3-1).

3. Disconnect the Function Generator from the 67XXA EXT FM input.

4. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 340. This calibrates the FM meter when there is no input voltage.

5. Reconnect the Function Generator to the EXT FM input.

6. On the 67XXA, press <Shift> TRIGGER 341. This calibrates the FM meter to a .707 Vrms input and saves the calibration data.

7. On the 67XXA, press <Shift> TRIGGER 089, then <Shift> TRIGGER 397 to generate new EEPROM checksums.

8. Restore the A23 CAL/NORM jumper to the NORM position. This completes the FM Meter calibration.

d. FM Meter Calibration Verification

1. To verify the previous FM Meter calibration, perform the following procedure.

2. On the 67XXA;
   - (a) Press FM.
   - (b) Press MEASURE FM DEV.
   - (c) Verify that the MODULATION display reads 300 kHz ±15 kHz.

SECTION IV
TEST RECORD

CONTENTS

Paragraph	Description	Page
4-1	INTRODUCTION	4-3
4-2	PERFORMANCE VERIFICATION TEST RECORD	4-3
4-3	CALIBRATION/ADJUSTMENTS TEST RECORD	4-3

SECTION IV
TEST RECORDS

4-1 INTRODUCTION

This section provides two Test Record tables for recording the results of the Performance Verification Tests (in Section 2) and the Calibration/Adjustments (in Section 3). They jointly provide the means for maintaining an accurate and complete record of instrument performance.

This test record provided here has been customized for the 6759A and 6759A-10 models. It should only be used with matching procedures in Section 2 and 3 that cover the 6759A or 6759A-10 models. Specific references to frequency parameters, power levels, and non-applicable procedures make each Test Record easy to follow.

We recommend that you make a copy of these pages each time the test procedures are performed. By dating each Test Record copy, a detailed history of instrument perfomance can be accumulated.

4-2 PERFORMANCE VERIFICATION TEST RECORD

The Test Record for the Performance Verification procedures supplied in Section 2 is located immediately following this page.

4-3 CALIBRATION/ADJUSTMENTS TEST RECORD

The Test Record for the Calibration/Adjustment procedures supplied in Section 3 follows the Performance Verification Test Record.

NOTE

Results of the automated RF Level Calibration procedure in Section 3 are not included in this Test Record. Calibration data is stored in instrument memory. Contact Customer Service at (408) 778-2000 for more details.

WILTRON Model 6759A and 6759A-10 **Date:** ____________________

Serial Number ____________________ **Tested By:** ____________________

2-5. Internal Time Base Aging Rate Test

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. Test Procedure				
2	Record T_S value		______hours	
3	Record T_1 value		______sec	
4	Record T_2 value		______sec	
5	Record T_F value		______hours	
7	Record the calculated aging rate		______per day	1×10^{-9} per day

2-6. Frequency Synthesis Tests

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. Coarse Loop/YIG Loop Test Procedure				
1(c)	Enter 1 GHz			
2	Record the Frequency Counter Reading	0.999 999 900 GHz	____________ GHz	1.000 000 100 GHz
3	Record the Frequency Counter Reading	1.999 999 900 GHz	____________ GHz	2.000 000 100 GHz
4	Record the Frequency Counter Readings . . .	2.999 999 900 GHz	____________ GHz	3.000 000 100 GHz
		3.999 999 900 GHz	____________ GHz	4.000 000 100 GHz
		4.999 999 900 GHz	____________ GHz	5.000 000 100 GHz
		5.999 999 900 GHz	____________ GHz	6.000 000 100 GHz
		6.999 999 900 GHz	____________ GHz	7.000 000 100 GHz
		7.999 999 900 GHz	____________ GHz	8.000 000 100 GHz
		8.999 999 900 GHz	____________ GHz	9.000 000 100 GHz
		9.999 999 900 GHz	____________ GHz	10.000 000 100 GHz
		10.999 999 900 GHz	____________ GHz	11.000 000 100 GHz
		11.999 999 900 GHz	____________ GHz	12.000 000 100 GHz
		12.999 999 900 GHz	____________ GHz	13.000 000 100 GHz
		13.999 999 900 GHz	____________ GHz	14.000 000 100 GHz
		14.999 999 900 GHz	____________ GHz	15.000 000 100 GHz
		15.999 999 900 GHz	____________ GHz	16.000 000 100 GHz
		16.999 999 900 GHz	____________ GHz	17.000 000 100 GHz
		17.999 999 900 GHz	____________ GHz	18.000 000 100 GHz
		18.999 999 900 GHz	____________ GHz	19.000 000 100 GHz
		19.999 999 900 GHz	____________ GHz	20.000 000 100 GHz
		20.999 999 900 GHz	____________ GHz	21.000 000 100 GHz
		21.999 999 900 GHz	____________ GHz	22.000 000 100 GHz
		22.999 999 900 GHz	____________ GHz	23.000 000 100 GHz
		23.999 999 900 GHz	____________ GHz	24.000 000 100 GHz
		24.999 999 900 GHz	____________ GHz	25.000 000 100 GHz
		25.999 999 900 GHz	____________ GHz	26.000 000 100 GHz

2-6. Frequency Synthesis Tests (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
d. Fine Loop Test Procedure				
1(c)	Enter 1 GHz			
2	Record the Frequency Counter Reading	0.999 999 900 GHz	____________ GHz	1.000 000 100 GHz
3	Record the Frequency Counter Reading	1.000 000 900 GHz	____________ GHz	1.000 001 100 GHz
4	Record the Frequency Counter Readings . . .	1.000 001 900 GHz	____________ GHz	1.000 002 100 GHz
		1.000 002 900 GHz	____________ GHz	1.000 003 100 GHz
		1.000 003 900 GHz	____________ GHz	1.000 004 100 GHz
		1.000 004 900 GHz	____________ GHz	1.000 005 100 GHz
		1.000 005 900 GHz	____________ GHz	1.000 006 100 GHz
		1.000 006 900 GHz	____________ GHz	1.000 007 100 GHz
		1.000 007 900 GHz	____________ GHz	1.000 008 100 GHz
		1.000 008 900 GHz	____________ GHz	1.000 009 100 GHz
		1.000 009 900 GHz	____________ GHz	1.000 010 100 GHz

2-7. Marker and Blanking Verification

Step	*Procedure Comments*	*Marker/Signal Presence*
c. Marker Selection Procedure		
2	F1 Frequency Marker = 0.01 GHz	
2	Verify that a marker appears on the left side of the scope at the start of trace	______
3(a)	F2 Frequency Marker = 26.5 GHz	
3(b)	Verify that a marker appears on the right side of the scope at the end of trace	______
4	F3 Frequency Marker = 1 GHz	
4	Verify that a marker appears on the scope	______
4	F4 Frequency Marker = 5 GHz	
4	Verify that a marker appears on the scope	______
4	F5 Frequency Marker = 10 GHz	
4	Verify that a marker appears on the scope	______
4	F6 Frequency Marker = 15 GHz	
4	Verify that a marker appears on the scope	______
4	F7 Frequency Marker = 18 GHz	
4	Verify that a marker appears on the scope	______
4	F8 Frequency Marker = 20 GHz	
4	Verify that a marker appears on the scope	______
4	F9 Frequency Marker = 23 GHz	
4	Verify that a marker appears on the scope	______
d. Marker Output Verification Procedure		
1	Verify +5V (TTL high) markers at nine points on scope display	______
3	Verify that all markers change to intensified spots	______
5(a)	Verify +5V (TTL high) signal at retrace	______
5(b)	Verify +5V signal at bandswitch point	______
5(c)	Verify +5V signal at each switched filter point:	
	3.5 GHz switch point	______
	6.0 GHz switch point	______
5(d)	Verify –10V signal at selected marker frequency	______
5(e)	Verify –5V signal at all other marker frequencies	______
6	Verify that new marker changes from –5V to –10V	______
	Verify that previous marker changes from –10V to –5V	______
e. Retrace Blanking Output Verification Procedure		
2	Verify –5V signal during retrace	______
3	Verify +5V signal during retrace	______
f. Bandswitch Blanking Output Verification Procedure		
2	Verify +5V signal during the following bandswitch dwell points:	
	2.0 GHz bandswitch dwell point	______
	8.0 GHz bandswitch dwell point	______
	12.4 GHz bandswitch dwell point	______
	18 GHz bandswitch dwell point	______
3	Verify –5V signal during the following bandswitch dwell points:	
	2.0 GHz bandswitch dwell point	______
	8.0 GHz bandswitch dwell point	______
	12.4 GHz bandswitch dwell point	______
	18 GHz bandswitch dwell point	______

2-8. Narrowband Spurious Tests

Step	Procedure Comments	Lower Limit	Measured Value	Upper Limit
c. Fine Loop Test Procedure				
1(b)	Enter 5.1 GHz.			
3	Record the presence of all spurious signals at a carrier offset of:			
	10 kHz	N/A	_______dBc	–60 dBc
	20 kHz	N/A	_______dBc	–60 dBc
	30 kHz	N/A	_______dBc	–60 dBc
	40 kHz	N/A	_______dBc	–60 dBc
	50 kHz	N/A	_______dBc	–60 dBc
d. Coarse Loop Test Procedure				
1(b)	Enter 18.3 GHz.			
3	Record the presence of all spurious signals at a carrier offset of:			
	200 kHz	N/A	_______dBc	–60 dBc
	400 kHz	N/A	_______dBc	–60 dBc

2-9. Spurious and Harmonic Tests: RF Output Signals ≤2 GHz

Step	Procedure Comments	Lower Limit	Measured Value	Upper Limit
c. Test Procedure				
3	Record the presence of the worst case harmonic of the 10 MHz carrier	N/A	_______dBc	–30 dBc
3	Record the presence of the worst case spurious response on the Spectrum Analyzer display	N/A	_______dBc	–40 dBc
4	Record the presence of the worst case harmonic of the 20 MHz carrier	N/A	_______dBc	–30 dBc
4	Record the presence of the worst case spurious response on the Spectrum Analyzer display	N/A	_______dBc	–40 dBc
4	Record the presence of the worst case harmonics of the 30 MHz carrier	N/A	_______dBc	–30 dBc
4	Record the presence of the worst case spurious response on the Spectrum Analyzer display	N/A	_______dBc	–40 dBc
6	Record the presence of the worst case harmonic of the 40 MHz carrier	N/A	_______dBc	–30 dBc
6	Record the presence of the worst case spurious response on the Spectrum Analyzer display	N/A	_______dBc	–40 dBc
8	Record the presence of the worst case harmonic of the 350 MHz carrier	N/A	_______dBc	–30 dBc
8	Record the presence of the worst case spurious response on the Spectrum Analyzer display	N/A	_______dBc	–40 dBc
9	Record the presence of the worst case spurious response of the 1.6 GHz carrier on the Spectrum Analyzer display	N/A	_______dBc	–40 dBc
12	Record the level of harmonics of the 1.6 GHz carrier:			
	3.2 GHz (2nd harmonic)	N/A	_______dBc	–30 dBc
	4.8 GHz (3rd harmonic)	N/A	_______dBc	–30 dBc

2-10. Harmonic Tests: RF Output Signals From 2 to 10 GHz

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. Test Procedure				
4	Record the level of all harmonics of the 2.1 GHz carrier:			
	4.2 GHz (2nd harmonic)	N/A	________dBc	–60 dBc
	6.3 GHz (3rd harmonic)	N/A	________dBc	–60 dBc
	8.4 GHz (4th harmonic)	N/A	________dBc	–60 dBc
	10.5 GHz (5th harmonic)	N/A	________dBc	–60 dBc
	12.6 GHz (6th harmonic)	N/A	________dBc	–60 dBc
	14.7 GHz (7th harmonic)	N/A	________dBc	–60 dBc
	16.8 GHz (8th harmonic)	N/A	________dBc	–60 dBc
	18.9 GHz (9th harmonic)	N/A	________dBc	–60 dBc
5	Record the level of all harmonics of the 3.6 GHz carrier:			
	7.2 GHz (2nd harmonic)	N/A	________dBc	–60 dBc
	10.8 GHz (3rd harmonic)	N/A	________dBc	–60 dBc
	14.4 GHz (4th harmonic)	N/A	________dBc	–60 dBc
	18 GHz (5th harmonic)	N/A	________dBc	–60 dBc
5	Record the level of all harmonics of the 7 GHz carrier:			
	14 GHz (2nd harmonic)	N/A	________dBc	–60 dBc
5	Record the level of all harmonics of the 10 GHz carrier:			
	20 GHz (2nd harmonic)	N/A	________dBc	–60 dBc

2-11. Harmonic Tests: RF Output Signals From 11 to 20 GHz

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. Test Procedure				
7	Record the level of the 2nd harmonic of the 11 GHz carrier:			
	22 GHz (2nd harmonic)	N/A	________dBc	–60 dBc
7	Record the level of the 2nd harmonic of the 12.4 GHz carrier:			
	24.8 GHz (2nd harmonic)	N/A	________dBc	–60 dBc
7	Record the level of the 2nd harmonic of the 13.25 GHz carrier:			
	26.5 GHz (2nd harmonic)	N/A	________dBc	–60 dBc

2-12. Harmonic Tests (Alternate Method): RF Output Signals From 10 to 30 GHz

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. Test Procedure				
2 (c)	Enter 10 GHz			
4	Measure and record the difference between RF levels above and below filter cutoff:			
	10 to 20 GHz harmonic level	N/A	________dBc	–60 dBc
5	Enter 20 GHz Measure and record the difference between RF levels above and below filter cutoff:			
	20 to 26.5 GHz harmonic level	N/A	________dBc	–60 dBc

2-13. Harmonic Tests: RF Output Signals From 26.5 to 40 GHz

These tests are not applicable to the 6759A and 6759A-10 models.

2-14. Power Level Accuracy and Flatness Verification (6759A Models without Optional Attenuator)

c. Power Level Flatness Procedure

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
2	Measure and record the maximum power level reading (step sweep)		_______ dBm	* dBm
2	Measure and record the minimum power level reading (step sweep)	* dBm	_______ dBm	
4	Measure and record the maximum power level reading (analog sweep; typical, not a spec) . .		_______ dBm	** dBm
4	Measure and record the minimum power level reading (analog sweep; typical, not a spec) . .	** dBm	_______ dBm	

* = Maximum Variation is 0.8 dB

** = Maximum Variation is 2.0 dB (0.01 to 20 GHz)/3.0 dB (20 to 26.5 GHz)

d. Power Level Accuracy Procedure (0.01 to 2 GHz)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
1(c)	Enter 50 MHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+4.4 dBm	_______ dBm	+5.6 dBm
3	Measure and record the Power Meter reading	+3.4 dBm	_______ dBm	+4.6 dBm
4	Measure and record the Power Meter readings	+2.4 dBm	_______ dBm	+3.6 dBm
		+1.4 dBm	_______ dBm	+2.6 dBm
		+0.4 dBm	_______ dBm	+1.6 dBm
		−0.6 dBm	_______ dBm	+0.6 dBm
		−1.6 dBm	_______ dBm	−0.4 dBm
		−2.6 dBm	_______ dBm	−1.4 dBm
		−3.6 dBm	_______ dBm	−2.4 dBm
		−4.6 dBm	_______ dBm	−3.4 dBm
		−5.6 dBm	_______ dBm	−4.4 dBm
		−6.6 dBm	_______ dBm	−5.4 dBm
		−7.6 dBm	_______ dBm	−6.4 dBm

d. Power Level Accuracy Procedure (2 to 8 GHz)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
1(c)	Enter 2.050 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+4.4 dBm	_______ dBm	+5.6 dBm
3	Measure and record the Power Meter reading	+3.4 dBm	_______ dBm	+4.6 dBm
4	Measure and record the Power Meter readings	+2.4 dBm	_______ dBm	+3.6 dBm
		+1.4 dBm	_______ dBm	+2.6 dBm
		+0.4 dBm	_______ dBm	+1.6 dBm
		−0.6 dBm	_______ dBm	+0.6 dBm
		−1.6 dBm	_______ dBm	−0.4 dBm
		−2.6 dBm	_______ dBm	−1.4 dBm
		−3.6 dBm	_______ dBm	−2.4 dBm
		−4.6 dBm	_______ dBm	−3.4 dBm
		−5.6 dBm	_______ dBm	−4.4 dBm
		−6.6 dBm	_______ dBm	−5.4 dBm
		−7.6 dBm	_______ dBm	−6.4 dBm

2-14. Power Level Accuracy and Flatness Verification (6759A Models without Optional Attenuator) (Continued)

Step	Procedure Comments	Lower Limit	Measured Value	Upper Limit
d.Power Level Accuracy Procedure (8 to 12.4 GHz)				
1(c)	Enter 8.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+4.4 dBm	_________ dBm	+5.6 dBm
3	Measure and record the Power Meter reading	+3.4 dBm	_________ dBm	+4.6 dBm
4	Measure and record the Power Meter readings	+2.4 dBm	_________ dBm	+3.6 dBm
		+1.4 dBm	_________ dBm	+2.6 dBm
		+0.4 dBm	_________ dBm	+1.6 dBm
		–0.6 dBm	_________ dBm	+0.6 dBm
		–1.6 dBm	_________ dBm	–0.4 dBm
		–2.6 dBm	_________ dBm	–1.4 dBm
		–3.6 dBm	_________ dBm	–2.4 dBm
		–4.6 dBm	_________ dBm	–3.4 dBm
		–5.6 dBm	_________ dBm	–4.4 dBm
		–6.6 dBm	_________ dBm	–5.4 dBm
		–7.6 dBm	_________ dBm	–6.4 dBm
d. Power Level Accuracy Procedure (12.4 to 18 GHz)				
1(c)	Enter 12.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+4.4 dBm	_________ dBm	+5.6 dBm
3	Measure and record the Power Meter reading	+3.4 dBm	_________ dBm	+4.6 dBm
4	Measure and record the Power Meter readings	+2.4 dBm	_________ dBm	+3.6 dBm
		+1.4 dBm	_________ dBm	+2.6 dBm
		+0.4 dBm	_________ dBm	+1.6 dBm
		–0.6 dBm	_________ dBm	+0.6 dBm
		–1.6 dBm	_________ dBm	–0.4 dBm
		–2.6 dBm	_________ dBm	–1.4 dBm
		–3.6 dBm	_________ dBm	–2.4 dBm
		–4.6 dBm	_________ dBm	–3.4 dBm
		–5.6 dBm	_________ dBm	–4.4 dBm
		–6.6 dBm	_________ dBm	–5.4 dBm
		–7.6 dBm	_________ dBm	–6.4 dBm
d. Power Level Accuracy Procedure (18 to 26.5 GHz)				
1(c)	Enter 18 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+4.4 dBm	_________ dBm	+5.6 dBm
3	Measure and record the Power Meter reading	+3.4 dBm	_________ dBm	+4.6 dBm
4	Measure and record the Power Meter readings	+2.4 dBm	_________ dBm	+3.6 dBm
		+1.4 dBm	_________ dBm	+2.6 dBm
		+0.4 dBm	_________ dBm	+1.6 dBm
		–0.6 dBm	_________ dBm	+0.6 dBm
		–1.6 dBm	_________ dBm	–0.4 dBm
		–2.6 dBm	_________ dBm	–1.4 dBm
		–3.6 dBm	_________ dBm	–2.4 dBm
		–4.6 dBm	_________ dBm	–3.4 dBm
		–5.6 dBm	_________ dBm	–4.4 dBm
		–6.6 dBm	_________ dBm	–5.4 dBm
		–7.6 dBm	_________ dBm	–6.4 dBm

2-14. Power Level Accuracy and Flatness Verification (6759A Models with 90 dB or 110 dB Optional Attenuator)

c. Power Level Flatness Procedure

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
2	Measure and record the maximum power level reading (step sweep)		________ dBm	* dBm
2	Measure and record the minimum power level reading (step sweep)	* dBm	________ dBm	
4	Measure and record the maximum power level reading (analog sweep; typical, not a spec) . .		________ dBm	** dBm
4	Measure and record the minimum power level reading (analog sweep; typical, not a spec) . .	** dBm	________ dBm	

* = Maximum Variation is 1.6 dB (0.01 to 20 GHz)/2.0 dB (20 to 26.5 GHz)

** = Maximum Variation is 6.0 dB (0.01 to 20 GHz)/6.2 dB (20 to 26.5 GHz)

d. Power Level Accuracy Procedure (0.01 to 2 GHz)

1(c)	Enter 50 MHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+0.6 dBm	________ dBm	+3.4 dBm
3	Measure and record the Power Meter reading	–0.4 dBm	________ dBm	+2.4 dBm
4	Measure and record the Power Meter readings	–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBm	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm
		–7.4 dBm	________ dBm	–4.6 dBm
		–8.4 dBm	________ dBm	–5.6 dBm
		–9.4 dBm	________ dBm	–6.6 dBm
		–10.4 dBm	________ dBm	–7.6 dBm
		–11.4 dBm	________ dBm	–8.6 dBm

d. Power Level Accuracy Procedure (2 to 8 GHz)

1(c)	Enter 2.050 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+0.6 dBm	________ dBm	+3.4 dBm
3	Measure and record the Power Meter reading	–0.4 dBm	________ dBm	+2.4 dBm
4	Measure and record the Power Meter readings	–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBm	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm
		–7.4 dBm	________ dBm	–4.6 dBm
		–8.4 dBm	________ dBm	–5.6 dBm
		–9.4 dBm	________ dBm	–6.6 dBm
		–10.4 dBm	________ dBm	–7.6 dBm
		–11.4 dBm	________ dBm	–8.6 dBm

2-14. Power Level Accuracy and Flatness Verification (6759A Models with 90 dB or 110 dB Optional Attenuator) (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
d. Power Level Accuracy Procedure (8 to 12.4 GHz)				
1(c)	Enter 8.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+0.6 dBm	________ dBm	+3.4 dBm
3	Measure and record the Power Meter reading	–0.4 dBm	________ dBm	+2.4 dBm
4	Measure and record the Power Meter readings	–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBm	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm
		–7.4 dBm	________ dBm	–4.6 dBm
		–8.4 dBm	________ dBm	–5.6 dBm
		–9.4 dBm	________ dBm	–6.6 dBm
		–10.4 dBm	________ dBm	–7.6 dBm
		–11.4 dBm	________ dBm	–8.6 dBm
d. Power Level Accuracy Procedure (12.4 to 18 GHz)				
1(c)	Enter 12.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+0.6 dBm	________ dBm	+3.4 dBm
3	Measure and record the Power Meter reading	–0.4dBm	________ dBm	+2.4 dBm
4	Measure and record the Power Meter readings	–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBm	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm
		–7.4 dBm	________ dBm	–4.6 dBm
		–8.4 dBm	________ dBm	–5.6 dBm
		–9.4 dBm	________ dBm	–6.6 dBm
		–10.4 dBm	________ dBm	–7.6 dBm
		–11.4 dBm	________ dBm	–8.6 dBm
d. Power Level Accuracy Procedure (18 to 26.5 GHz)				
1(c)	Enter 18 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+0.6 dBm	________ dBm	+3.4 dBm
3	Measure and record the Power Meter reading	–0.4 dBm	________ dBm	+2.4 dBm
4	Measure and record the Power Meter readings	–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBM	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm
		–7.4 dBm	________ dBm	–4.6 dBm
		–8.4 dBm	________ dBm	–5.6 dBm
		–9.4 dBm	________ dBm	–6.6 dBm
		–10.4 dBm	________ dBm	–7.6 dBm
		–11.4 dBm	________ dBm	–8.6 dBm

2-14. Power Level Accuracy and Flatness Verification (6759A-10 Models without Optional Attenuator)

c. Power Level Flatness Procedure

Step	Procedure Comments	Lower Limit	Measured Value	Upper Limit
2	Measure and record the maximum power level reading (step sweep)		________ dBm	* dBm
2	Measure and record the minimum power level reading (step sweep)	* dBm	________ dBm	
4	Measure and record the maximum power level reading (analog sweep; typical, not a spec) . .		________ dBm	** dBm
4	Measure and record the minimum power level reading (analog sweep; typical, not a spec) . .	** dBm	________ dBm	

* = Maximum Variation is 0.8 dB

** = Maximum Variation is 2.0 dB (0.01 to 20 GHz)/3.0 dB (20 to 26.5 GHz)

d. Power Level Accuracy Procedure (0.01 to 2 GHz)

Step	Procedure Comments	Lower Limit	Measured Value	Upper Limit
1(c)	Enter 50 MHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+9.4 dBm	________ dBm	+10.6 dBm
3	Measure and record the Power Meter reading	+8.4 dBm	________ dBm	+9.6 dBm
4	Measure and record the Power Meter readings	+7.4 dBm	________ dBm	+8.6 dBm
		+6.4 dBm	________ dBm	+7.6 dBm
		+5.4 dBm	________ dBm	+6.6 dBm
		+4.4 dBm	________ dBm	+5.6 dBm
		+3.4 dBm	________ dBm	+4.6 dBm
		+2.4 dBm	________ dBm	+3.6 dBm
		+1.4 dBm	________ dBm	+2.6 dBm
		+0.4 dBm	________ dBm	+1.6 dBm
		–0.6 dBm	________ dBm	+0.6 dBm
		–1.6 dBm	________ dBm	–0.4 dBm
		–2.6 dBm	________ dBm	–1.4 dBm

d. Power Level Accuracy Procedure (2 to 8 GHz)

Step	Procedure Comments	Lower Limit	Measured Value	Upper Limit
1(c)	Enter 2.050 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+9.4 dBm	________ dBm	+10.6 dBm
3	Measure and record the Power Meter reading	+8.4 dBm	________ dBm	+9.6 dBm
4	Measure and record the Power Meter readings	+7.4 dBm	________ dBm	+8.6 dBm
		+6.4 dBm	________ dBm	+7.6 dBm
		+5.4 dBm	________ dBm	+6.6 dBm
		+4.4 dBm	________ dBm	+5.6 dBm
		+3.4 dBm	________ dBm	+4.6 dBm
		+2.4 dBm	________ dBm	+3.6 dBm
		+1.4 dBm	________ dBm	+2.6 dBm
		+0.4 dBm	________ dBm	+1.6 dBm
		–0.6 dBm	________ dBm	+0.6 dBm
		–1.6 dBm	________ dBm	–0.4 dBm
		–2.6 dBm	________ dBm	–1.4 dBm

2-14. Power Level Accuracy and Flatness Verification (6759A-10 Models without Optional Attenuator) (Continued)

d. Power Level Accuracy Procedure (8 to 12.4 GHz)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
1(c)	Enter 8.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+9.4 dBm	________ dBm	+10.6 dBm
3	Measure and record the Power Meter reading	+8.4 dBm	________ dBm	+9.6 dBm
4	Measure and record the Power Meter readings	+7.4 dBm	________ dBm	+8.6 dBm
		+6.4 dBm	________ dBm	+7.6 dBm
		+5.4 dBm	________ dBm	+6.6 dBm
		+4.4 dBm	________ dBm	+5.6 dBm
		+3.4 dBm	________ dBm	+4.6 dBm
		+2.4 dBm	________ dBm	+3.6 dBm
		+1.4 dBm	________ dBm	+2.6 dBm
		+0.4 dBm	________ dBm	+1.6 dBm
		–0.6 dBm	________ dBm	+0.6 dBm
		–1.6 dBm	________ dBm	–0.4 dBm
		–2.6 dBm	________ dBm	–1.4 dBm

d. Power Level Accuracy Procedure (12.4 to 18 GHz)

1(c)	Enter 12.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+9.4 dBm	________ dBm	+10.6 dBm
3	Measure and record the Power Meter reading	+8.4 dBm	________ dBm	+9.6 dBm
4	Measure and record the Power Meter readings	+7.4 dBm	________ dBm	+8.6 dBm
		+6.4 dBm	________ dBm	+7.6 dBm
		+5.4 dBm	________ dBm	+6.6 dBm
		+4.4 dBm	________ dBm	+5.6 dBm
		+3.4 dBm	________ dBm	+4.6 dBm
		+2.4 dBm	________ dBm	+3.6 dBm
		+1.4 dBm	________ dBm	+2.6 dBm
		+0.4 dBm	________ dBm	+1.6 dBm
		–0.6 dBm	________ dBm	+0.6 dBm
		–1.6 dBm	________ dBm	–0.4 dBm
		–2.6 dBm	________ dBm	–1.4 dBm

d. Power Level Accuracy Procedure (18 to 26.5 GHz)

1(c)	Enter 18 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+9.4 dBm	________ dBm	+10.6 dBm
3	Measure and record the Power Meter reading	+8.4 dBm	________ dBm	+9.6 dBm
4	Measure and record the Power Meter readings	+7.4 dBm	________ dBm	+8.6 dBm
		+6.4 dBm	________ dBm	+7.6 dBm
		+5.4 dBm	________ dBm	+6.6 dBm
		+4.4 dBm	________ dBm	+5.6 dBm
		+3.4 dBm	________ dBm	+4.6 dBm
		+2.4 dBm	________ dBm	+3.6 dBm
		+1.4 dBm	________ dBm	+2.6 dBm
		+0.4 dBm	________ dBm	+1.6 dBm
		–0.6 dBm	________ dBm	+0.6 dBm
		–1.6 dBm	________ dBm	–0.4 dBm
		–2.6 dBm	________ dBm	–1.4 dBm

2-14. Power Level Accuracy and Flatness Verification (6759A-10 Models with 90 dB or 110 dB Optional Attenuator)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. Power Level Flatness Procedure				
2	Measure and record the maximum power level reading (step sweep)		_________ dBm	* dBm
2	Measure and record the minimum power level reading (step sweep)	* dBm	_________ dBm	
4	Measure and record the maximum power level reading (analog sweep; typical, not a spec) . .		_________ dBm	** dBm
4	Measure and record the minimum power level reading (analog sweep; typical, not a spec) . .	** dBm	_________ dBm	

* = Maximum Variation is 1.6 dB (0.01 to 20 GHz)/2.0 dB (20 to 26.5GHz)

** = Maximum Variation is 6.0 dB (0.01 to 20 GHz)/6.2 dB (20 to 26.5 GHz)

d. Power Level Accuracy Procedure (0.01 to 2 GHz)

1(c)	Enter 50 MHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+5.6 dBm	_________ dBm	+8.4 dBm
3	Measure and record the Power Meter reading	+4.6 dBm	_________ dBm	+7.4 dBm
4	Measure and record the Power Meter readings	+3.6 dBm	_________ dBm	+6.4 dBm
		+2.6 dBm	_________ dBm	+5.4 dBm
		+1.6 dBm	_________ dBm	+4.4 dBm
		+0.6 dBm	_________ dBm	+3.4 dBm
		–0.4 dBm	_________ dBm	+2.4 dBm
		–1.4 dBm	_________ dBm	+1.4 dBm
		–2.4 dBm	_________ dBm	+0.4 dBm
		–3.4 dBm	_________ dBm	–0.6 dBm
		–4.4 dBm	_________ dBm	–1.6 dBm
		–5.4 dBm	_________ dBm	–2.6 dBm
		–6.4 dBm	_________ dBm	–3.6 dBm

d. Power Level Accuracy Procedure (2 to 8 GHz)

1(c)	Enter 2.050 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+5.6 dBm	_________ dBm	+8.4 dBm
3	Measure and record the Power Meter reading	+4.6 dBm	_________ dBm	+7.4 dBm
4	Measure and record the Power Meter readings	+3.6 dBm	_________ dBm	+6.4 dBm
		+2.6 dBm	_________ dBm	+5.4 dBm
		+1.6 dBm	_________ dBm	+4.4 dBm
		+0.6 dBm	_________ dBm	+3.4 dBm
		–0.4 dBm	_________ dBm	+2.4 dBm
		–1.4 dBm	_________ dBm	+1.4 dBm
		–2.4 dBm	_________ dBm	+0.4 dBm
		–3.4 dBm	_________ dBm	–0.6 dBm
		–4.4 dBm	_________ dBm	–1.6 dBm
		–5.4 dBm	_________ dBm	–2.6 dBm
		–6.4 dBm	_________ dBm	–3.6 dBm

2-14. Power Level Accuracy and Flatness Verification (6759A-10 Models with 90 dB or 110 dB Optional Attenuator) (Continued)

Step	Procedure Comments	Lower Limit	Measured Value	Upper Limit
d. Power Level Accuracy Procedure (8 to 12.4 GHz)				
1(c)	Enter 8.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+5.6 dBm	________ dBm	+8.4 dBm
3	Measure and record the Power Meter reading	+4.6 dBm	________ dBm	+7.4 dBm
4	Measure and record the Power Meter readings	+3.6 dBm	________ dBm	+6.4 dBm
		+2.6 dBm	________ dBm	+5.4 dBm
		+1.6 dBm	________ dBm	+4.4 dBm
		+0.6 dBm	________ dBm	+3.4 dBm
		–0.4 dBm	________ dBm	+2.4 dBm
		–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBm	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm
d. Power Level Accuracy Procedure (12.4 to 18 GHz)				
1(c)	Enter 12.450 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+5.6 dBm	________ dBm	+8.4 dBm
3	Measure and record the Power Meter reading	+4.6 dBm	________ dBm	+7.4 dBm
4	Measure and record the Power Meter readings	+3.6 dBm	________ dBm	+6.4 dBm
		+2.6 dBm	________ dBm	+5.4 dBm
		+1.6 dBm	________ dBm	+4.4 dBm
		+0.6 dBm	________ dBm	+3.4 dBm
		–0.4 dBm	________ dBm	+2.4 dBm
		–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBm	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm
d. Power Level Accuracy Procedure (18 to 26.5 GHz)				
1(c)	Enter 18 GHz			
2	Measure and record the Power Meter reading at maximum leveled power (LEVEL 1)	+5.6 dBm	________ dBm	+8.4 dBm
3	Measure and record the Power Meter reading	+4.6 dBm	________ dBm	+7.4 dBm
4	Measure and record the Power Meter readings	+3.6 dBm	________ dBm	+6.4 dBm
		+2.6 dBm	________ dBm	+5.4 dBm
		+1.6 dBm	________ dBm	+4.4 dBm
		+0.6 dBm	________ dBm	+3.4 dBm
		–0.4 dBm	________ dBm	+2.4 dBm
		–1.4 dBm	________ dBm	+1.4 dBm
		–2.4 dBm	________ dBm	+0.4 dBm
		–3.4 dBm	________ dBm	–0.6 dBm
		–4.4 dBm	________ dBm	–1.6 dBm
		–5.4 dBm	________ dBm	–2.6 dBm
		–6.4 dBm	________ dBm	–3.6 dBm

2-15. FM Modulation Tests

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. FM Input Sensitivity Procedure (Band 0; 0.01 to 2 GHz)				
2(c)	Enter 1.1 GHz			
5	Measure and record the signal level of the Bessel null displayed on the Spectrum Analyzer	26 dB decrease	______ dB decrease	N/A
d. FM Meter Accuracy Procedure (Band 0; 0.01 to 2 GHz)				
1	Record the number in the MODULATION display			________
2	Divide 9216 by the number noted in the previous line			________
5	Measure and record the decrease in carrier level	26 dB decrease	______ dB decrease	N/A
6	Repeat steps c.2 through d.5 for the remaining bands.			
c. FM Input Sensitivity Procedure (Band 1; 2 to 8 GHz)				
2(c)	Enter 5 GHz			
5	Measure and record the signal level of the Bessel null displayed on the Spectrum Analyzer	26 dB decrease	______ dB decrease	N/A
d. FM Meter Accuracy Procedure (Band 1; 2 to 8 GHz)				
1	Record the number in the MODULATION display			________
2	Divide 9216 by the number noted in the previous line			________
5	Measure and record the decrease in carrier level	26 dB decrease	______ dB decrease	N/A
c. FM Input Sensitivity Procedure (Band 2; 8 to 12.4 GHz)				
2(c)	Enter 10 GHz			
5	Measure and record the signal level of the Bessel null displayed on the Spectrum Analyzer	26 dB decrease	______ dB decrease	N/A
d. FM Meter Accuracy Procedure (Band 2; 8 to 12.4 GHz)				
1	Record the number in the MODULATION display			________
2	Divide 9216 by the number noted in the previous line			________
5	Measure and record the decrease in carrier level	26 dB decrease	______ dB decrease	N/A
c. FM Input Sensitivity Procedure (Band 3; 12.4 to 18 GHz)				
2(c)	Enter 16 GHz			
5	Measure and record the signal level of the Bessel null displayed on the Spectrum Analyzer	26 dB decrease	______ dB decrease	N/A
d. FM Meter Accuracy Procedure (Band 3; 12.4 to 18 GHz)				
1	Record the number in the MODULATION display			________
2	Divide 9216 by the number noted in the previous line			________
5	Measure and record the decrease in carrier level	26 dB decrease	______ dB decrease	N/A
c. FM Input Sensitivity Procedure (Band 4; 18 to 26.5 GHz)				
2(c)	Enter 22 GHz			
5	Measure and record the signal level of the Bessel null displayed on the Spectrum Analyzer	26 dB decrease	______ dB decrease	N/A
d. FM Meter Accuracy Procedure (Band 4; 18 to 26.5 GHz)				
1	Record the number in the MODULATION display			________
2	Divide 9216 by the number noted in the previous line			________
5	Measure and record the decrease in carrier level	26 dB decrease	______ dB decrease	N/A

2-16. AM Modulation Tests

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. AM Input Sensitivity and Meter Accuracy (Band 0; 0.01 to 2 GHz)				
2(e)	Enter 1.1 GHz			
6	Measure and note the Modulation Analyzer AM PK (+) reading			______
8	Measure and note the Modulation Analyzer AM PK (–) reading			______
10	Calculate and note the actual AM sensitivity	26%	____%	34%
d. AM Meter Accuracy Procedure (Band 0; 0.01 to 2 GHz)				
3	Record the number in the MODULATION display			______
4	Divide 30 by the number noted in the previous line. Note the result			______
5	Multiply the result of the previous step by the result of the calculation in step c.10. Verify that the product of the calculation is between 26% and 34% AM	26%	______%	34%
6	Repeat steps c.2 through d.5 for the remaining bands.			
c. AM Input Sensitivity and Meter Accuracy (Band 1; 2 to 8 GHz)				
2(e)	Enter 5 GHz			
6	Measure and note the Modulation Analyzer AM PK (+) reading			______
8	Measure and note the Modulation Analyzer AM PK (–) reading			______
10	Calculate and note the actual AM sensitivity	26%	____%	34%
d. AM Meter Accuracy Procedure (Band 1; 2 to 8 GHz)				
3	Record the number in the MODULATION display			______
4	Divide 30 by the number noted in the previous line. Note the result			______
5	Multiply the result of the previous step by the result of the calculation in step c.10. Verify that the product of the calculation is between 26% and 34% AM	26%	______%	34%
c. AM Input Sensitivity and Meter Accuracy (Band 2; 8 to 12.4 GHz)				
2(e)	Enter 10 GHz			
6	Measure and note the Modulation Analyzer AM PK (+) reading			______
8	Measure and note the Modulation Analyzer AM PK (–) reading			______
10	Calculate and note the actual AM sensitivity	26%	____%	34%
d. AM Meter Accuracy Procedure (Band 2; 8 to 12.4 GHz)				
3	Record the number in the MODULATION display			______
4	Divide 30 by the number noted in the previous line. Note the result			______
5	Multiply the result of the previous step by the result of the calculation in step c.10. Verify that the product of the calculation is between 26% and 34% AM	26%	______%	34%
c. AM Input Sensitivity and Meter Accuracy (Band 3; 12.4 to 18 GHz)				
2(e)	Enter 16 GHz			
6	Measure and note the Modulation Analyzer AM PK (+) reading			______
8	Measure and note the Modulation Analyzer AM PK (–) reading			______
10	Calculate and note the actual AM sensitivity	26%	____%	34%
d. AM Meter Accuracy Procedure (Band 3; 12.4 to 18 GHz)				
3	Record the number in the MODULATION display			______
4	Divide 30 by the number noted in the previous line. Note the result			______
5	Multiply the result of the previous step by the result of the calculation in step c.10. Verify that the product of the calculation is between 26% and 34% AM	26%	______%	34%

2-16. AM Modulation Tests (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
d. AM Input Sensitivity and Meter Accuracy (Band 4; 18 to 26.5 GHz)				
2(e)	Enter 22 GHz			
6	Measure and note the Modulation Analyzer AM PK (+) reading			______
8	Measure and note the Modulation Analyzer AM PK (–) reading			______
10	Calculate and note the actual AM sensitivity . .	26%	____%	34%
d. AM Meter Accuracy Procedure (Band 4; 18 to 26.5 GHz)				
3	Record the number in the MODULATION display			______
4	Divide 30 by the number noted in the previous line. Note the result			______
5	Multiply the result of the previous step by the result of the calculation in step c.10. Verify that the product of the calculation is between 26% and 34% AM	26%	______%	34%

2-17. Pulse Modulation Tests: Rise Time, Fall Time, Overshoot, and Level

c. Rise Time, Fall Time, Overshoot, and Level (Bands 0 and 1; 0.01 to 8 GHz)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
1(c)	Enter 5 GHz Measure and record the following:			
2(a)	Rise Time	N/A	______ns	10 ns
2(b)	Pulse Width (typical; not a specification)	N/A	______µs	N/A
2(c)	Pulse Rate is 50 kHz	N/A	______kHz	N/A
2(d)	Overshoot (typical; not a specification)	N/A	______%	10%

c. Rise Time, Fall Time, Overshoot, and Level (Band 2; 8 to 12.4 GHz)

1(c)	Enter 10 GHz Measure and record the following:			
2(a)	Rise Time	N/A	______ns	10 ns
2(b)	Pulse Width (typical; not a specification)	N/A	______µs	N/A
2(c)	Pulse Rate is 50 kHz	N/A	______kHz	N/A
2(d)	Overshoot (typical; not a specification)	N/A	______%	10%

c. Rise Time, Fall Time, Overshoot, and Level (Band 3; 12.4 to 18 GHz)

1(c)	Enter 16 GHz Measure and record the following:			
2(a)	Rise Time	N/A	______ns	10 ns
2(b)	Pulse Width (typical; not a specification)	N/A	______µs	N/A
2(c)	Pulse Rate is 50 kHz	N/A	______kHz	N/A
2(d)	Overshoot (typical; not a specification)	N/A	______%	10%

c. Rise Time, Fall Time, Overshoot, and Level (Band 4; 18 to 26.5 GHz)

1(c)	Enter 22 GHz Measure and record the following:			
2(a)	Rise Time	N/A	______ns	10 ns
2(b)	Pulse Width (typical; not a specification)	N/A	______µs	N/A
2(c)	Pulse Rate is 50 kHz	N/A	______kHz	N/A
2(d)	Overshoot (typical; not a specification)	N/A	______%	10%

d. Pulse Leveling Accuracy Check, Preliminary Test Setup

4(b) Enter 1.1 GHz

e. 67XXA LEVEL Display Calibration

1	Note the 67XXA LEVEL display value	______dBm
2	Note the 67XXA LEVEL display value	______dBm
3	Calculate the difference between steps e.1 and e.2. Note this value	______dB

2-17. Pulse Modulation Tests: Rise Time, Fall Time, Overshoot, and Level (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
f. Pulse Level Accuracy Test Procedure (Band 0, 0.01 to 2 GHz; Pulse Width = 5 µs)				
2(b)	Enter 1.1 GHz			
4(c)	Enter 5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.3 dB	______dB	+0.3 dB
f. Pulse Level Accuracy Test Procedure (Band 0, 0.01 to 2 GHz; Pulse Width = 2 µs)				
2(b)	Enter 1.1 GHz			
4(c)	Enter 2 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.6 dB	______dB	+0.6 dB
f. Pulse Level Accuracy Test Procedure (Band 0, 0.01 to 2 GHz; Pulse Width = 1 µs)				
2(b)	Enter 1.1 GHz			
4(c)	Enter 1 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.9 dB	______dB	+0.9 dB
f. Pulse Level Accuracy Test Procedure (Band 0, 0.01 to 2 GHz; Pulse Width = 0.5 µs)				
2(b)	Enter 1.1 GHz			
4(c)	Enter 0.5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–1.2 dB	______dB	+1.2 dB

2-17. Pulse Modulation Tests: Rise Time, Fall Time, Overshoot, and Level (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
f. Pulse Level Accuracy Test Procedure (Band 1, 2 to 8 GHz; Pulse Width = 5 µs)				
2(b)	Enter 5 GHz			
4(c)	Enter 5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.3 dB	______dB	+0.3 dB
f. Pulse Level Accuracy Test Procedure (Band 1, 2 to 8 GHz; Pulse Width = 2 µs)				
2(b)	Enter 5 GHz			
4(c)	Enter 2 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.3 dB	______dB	+0.3 dB
f. Pulse Level Accuracy Test Procedure (Band 1, 2 to 8 GHz; Pulse Width = 1 µs)				
2(b)	Enter 5 GHz			
4(c)	Enter 1 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.5 dB	______dB	+0.5 dB
f. Pulse Level Accuracy Test Procedure (Band 1, 2 to 8 GHz; Pulse Width = 0.5 µs)				
2(b)	Enter 5 GHz			
4(c)	Enter 0.5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.8 dB	______dB	+0.8 dB
f. Pulse Level Accuracy Test Procedure (Band 1, 2 to 8 GHz; Pulse Width = 0.2 µs)				
2(b)	Enter 5 GHz			
4(c)	Enter 0.2 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–1.5 dB	______dB	+1.5 dB
f. Pulse Level Accuracy Test Procedure (Band 1, 2 to 8 GHz; Pulse Width = 0.1 µs)				
2(b)	Enter 5 GHz			
4(c)	Enter 0.1 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–1.5 dB	______dB	+1.5 dB

2-17. Pulse Modulation Tests: Rise Time, Fall Time, Overshoot, and Level (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
f. Pulse Level Accuracy Test Procedure (Band 2, 8 to 12.4 GHz; Pulse Width = 5 µs)				
2(b)	Enter 10 GHz			
4(c)	Enter 5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.3 dB	______dB	+0.3 dB
f. Pulse Level Accuracy Test Procedure (Band 2, 8 to 12.4 GHz; Pulse Width = 2 µs)				
2(b)	Enter 10 GHz			
4(c)	Enter 2 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.3 dB	______dB	+0.3 dB
f. Pulse Level Accuracy Test Procedure (Band 2, 8 to 12.4 GHz; Pulse Width = 1 µs)				
2(b)	Enter 10 GHz			
4(c)	Enter 1 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.5 dB	______dB	+0.5 dB
f. Pulse Level Accuracy Test Procedure (Band 2, 8 to 12.4 GHz; Pulse Width = 0.5 µs)				
2(b)	Enter 10 GHz			
4(c)	Enter 0.5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.8 dB	______dB	+0.8 dB
f. Pulse Level Accuracy Test Procedure (Band 2, 8 to 12.4 GHz; Pulse Width = 0.2 µs)				
2(b)	Enter 10 GHz			
4(c)	Enter 0.2 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–1.5 dB	______dB	+1.5 dB
f. Pulse Level Accuracy Test Procedure (Band 2, 8 to 12.4 GHz; Pulse Width = 0.1 µs)				
2(b)	Enter 10 GHz			
4(c)	Enter 0.1 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–1.5 dB	______dB	+1.5 dB

2-17. Pulse Modulation Tests: Rise Time, Fall Time, Overshoot, and Level (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*

f. Pulse Level Accuracy Test Procedure (Band 3, 12.4 to 18 GHz; Pulse Width = 5 μs)

2(b)	Enter 16 GHz			
4(c)	Enter 5 μs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	−0.3 dB	______dB	+0.3 dB

f. Pulse Level Accuracy Test Procedure (Band 3, 12.4 to 18 GHz; Pulse Width = 2 μs)

2(b)	Enter 16 GHz			
4(c)	Enter 2 μs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	−0.3 dB	______dB	+0.3 dB

f. Pulse Level Accuracy Test Procedure (Band 3, 12.4 to 18 GHz; Pulse Width = 1 μs)

2(b)	Enter 16 GHz			
4(c)	Enter 1 μs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	−0.5 dB	______dB	+0.5 dB

f. Pulse Level Accuracy Test Procedure (Band 3, 12.4 to 18 GHz; Pulse Width = 0.5 μs)

2(b)	Enter 16 GHz			
4(c)	Enter 0.5 μs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	−0.8 dB	______dB	+0.8 dB

f. Pulse Level Accuracy Test Procedure (Band 3, 12.4 to 18 GHz; Pulse Width = 0.2 μs)

2(b)	Enter 16 GHz			
4(c)	Enter 0.2 μs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	−1.5 dB	______dB	+1.5 dB

f. Pulse Level Accuracy Test Procedure (Band 3, 12.4 to 18 GHz; Pulse Width = 0.1 μs)

2(b)	Enter 16 GHz			
4(c)	Enter 0.1 μs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	−1.5 dB	______dB	+1.5 dB

2-17. Pulse Modulation Tests: Rise Time, Fall Time, Overshoot, and Level (Continued)

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
f. Pulse Level Accuracy Test Procedure (Band 4, 18 to 26.5 GHz; Pulse Width = 5 µs)				
2(b)	Enter 22 GHz			
4(c)	Enter 5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.3 dB	______dB	+0.3 dB
f. Pulse Level Accuracy Test Procedure (Band 4, 18 to 26.5 GHz; Pulse Width = 2 µs)				
2(b)	Enter 22 GHz			
4(c)	Enter 2 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.3 dB	______dB	+0.3 dB
f. Pulse Level Accuracy Test Procedure (Band 4, 18 to 26.5 GHz; Pulse Width = 1 µs)				
2(b)	Enter 22 GHz			
4(c)	Enter 1 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.5 dB	______dB	+0.5 dB
f. Pulse Level Accuracy Test Procedure (Band 4, 18 to 26.5 GHz; Pulse Width = 0.5 µs)				
2(b)	Enter 22 GHz			
4(c)	Enter 0.5 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–0.8 dB	______dB	+0.8 dB
f. Pulse Level Accuracy Test Procedure (Band 4, 18 to 26.5 GHz; Pulse Width = 0.2 µs)				
2(b)	Enter 22 GHz			
4(c)	Enter 0.2 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–1.5 dB	______dB	+1.5 dB
f. Pulse Level Accuracy Test Procedure (Band 4, 18 to 26.5 GHz; Pulse Width = 0.1 µs)				
2(b)	Enter 22 GHz			
4(c)	Enter 0.1 µs			
6	Record the 67XXA LEVEL display value			______dBm
8	Record the 67XXA LEVEL display value			______dBm
9	Calculate and record the Pulse Level Error as the value noted in step f.6 minus that recorded in step f.8.	–1.5 dB	______dB	+1.5 dB

2-18. Pulse Modulation Test: Video Feedthrough

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
c. Test Procedure (Band 0; 0.01 to 2 GHz)				
1(c)	Enter 1.1 GHz			
3	Measure and record the Video Feedthrough voltage spikes (specification = <±5 mV peak).	N/A	______mV peak	±5 mV peak
4	Repeat steps c.1 through c.3 for the remaining bands.			
c. Test Procedure (Band 1; 2 to 8 GHz)				
1(c)	Enter 5 GHz			
3	Measure and record the Video Feedthrough voltage spikes (specification = <±5 mV peak).	N/A	______mV peak	±5 mV peak
c. Test Procedure (Band 2; 8 to 12.4 GHz)				
1(c)	Enter 10 GHz			
3	Measure and record the Video Feedthrough voltage spikes (specification = <±5 mV peak).	N/A	______mV peak	±5 mV peak
c. Test Procedure (Band 3; 12.4 to 18 GHz)				
1(c)	Enter 16 GHz			
3	Measure and record the Video Feedthrough voltage spikes (specification = <±5 mV peak).	N/A	______mV peak	±5 mV peak
e. Test Procedure (Band 4; 18 to 26.5 GHz)				
1(c)	Enter 22 GHz			
3	Measure and record the Video Feedthrough voltage spikes (specification = <±5 mV peak).	N/A	______mV peak	±5 mV peak

2-19. Pulse Modulation Test: RF On/Off Ratio

Step	*Procedure Comments*	*Lower Limit*	*Measured Value*	*Upper Limit*
	c. Test Procedure (Band 0; 0.01 to 2 GHz)			
1(d)	Enter 1.1 GHz			
4	Measure and record the peak of the signal on the Spectrum Analyzer. (Measured signal must be >60 dB below top graticule to meet specification; this represents an On/Off Ratio of >80 dB.)	60 dB	______dB	N/A
7	Repeat steps c.1 through c.5 for the remaining installed bands (for frequencies 0.01 to 20 GHz).			
	c. Test Procedure (Band 1; 2 to 8 GHz)			
1(d)	Enter 5 GHz			
4	Measure and record the peak of the signal on the Spectrum Analyzer. (Measured signal must be >60 dB below top graticule to meet specification; this represents an On/Off Ratio of >80 dB.)	60 dB	______dB	N/A
	c. Test Procedure (Band 2; 8 to 12.4 GHz)			
1(d)	Enter 10 GHz			
4	Measure and record the peak of the signal on the Spectrum Analyzer. (Measured signal must be >60 dB below top graticule to meet specification; this represents an On/Off Ratio of >80 dB.)	60 dB	______dB	N/A
	c. Test Procedure (Band 3; 12.4 to 18 GHz)			
1(d)	Enter 16 GHz			
4	Measure and record the peak of the signal on the Spectrum Analyzer. (Measured signal must be >60 dB below top graticule to meet specification; this represents an On/Off Ratio of >80 dB.)	60 dB	______dB	N/A
7	Shift to section d test setup and section e test procedure for installed frequency bands above 20 GHz.			
	f. Test Procedure (Band 4; 18 to 26.5 GHz)			
1(d)	Enter 22 GHz			
4	Measure and record the peak of the signal on the Spectrum Analyzer. (Measured signal must be >50 dB below top graticule to meet specification; this represents an On/Off Ratio of >70 dB.)	50 dB	______dB	N/A

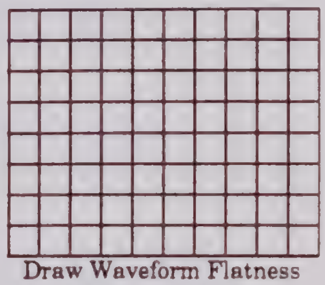
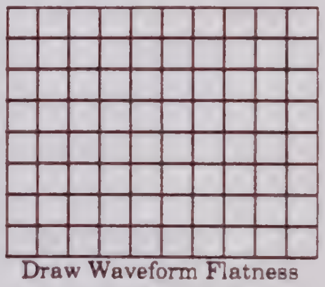
WILTRON Model 6759A and 6759A-10 Date: ____________________

Serial Number____________________ **Tested By:** ____________________

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-9 Power Supply Injection-Lock Adjustment Follow Adjustment Procedure Steps c.1 through c.7.		
3-10 ALC Level Offset Adjustments This instrument uses two leveling circuits; Band 0 (0.01–2.0 GHz) and Bands 1 through 4 (2 to 26.5 GHz).		
c. Band 0 Level Offset 1.(c) 3.	Frequency = 1.1 GHz A15TP6 = 0V ±50 µV	____________volts
d. Band 1 thru 4 Level Offset 1.(b) 3.	F1 = 5 GHz A15TP5 = 0V ±50 µV	____________volts
3-11 External Leveling Offset Adjustment c.5	A15TP4 = 0V ±1 mV	____________volts
3-12 10 MHz Reference Oscillator Calibration c.1.(c) c.3	Frequency = 26.5 GHz Adjust for Frequency Counter Reading = 26.5 GHz ±100 Hz	____________GHz

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-13 ALC Bandwidth Calibration		
This calibration is required for each installed frequency band:		
c. 0.01-2 GHz Band 2.(e)	Frequency = 1.1 GHz Follow steps c.1 through c.13.	
c. 2-8 GHz Band 2.(e)	Frequency = 5 GHz Repeat steps c.1 through c.13.	
c. 8-12.4 GHz Band 2.(e)	Frequency = 10 GHz Repeat steps c.1 through c.13.	
c. 12.4-18 GHz Band 2.(e)	Frequency = 16 GHz Repeat steps c.1 through c.13.	
c. 18-26.5 GHz Band 2.(e)	Frequency = 22 GHz Repeat steps c.1 through c.13.	
3-14 Analog Sweep Calibration		
This calibration is automatically completed for all of the installed frequency bands		
c.1.(d)	Frequency = 1.1 GHz	
3-15 FM Driver Calibration		
This calibration is automatically completed for all of the installed frequency bands.		
c.1.(d)	Frequency = 1.1 GHz	

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-16 YIG-tuned Oscillator Frequency Calibration This calibration is required for each installed frequency band:		
c. 0.01-2 GHz Band 1.(e) 5.	Frequency = 1.1 GHz Maximum difference in MHz between frequency counter and 6759A	________MHz
c. 2-8 GHz Band 1.(e) 5.	Frequency = 5 GHz Maximum difference in MHz between frequency counter and 6759A	________MHz
c. 8-12.4 GHz Band 1.(e) 5.	Frequency = 10 GHz Maximum difference in MHz between frequency counter and 6759A	________MHz
c. 12.4-18 GHz Band 1.(e) 5.	Frequency =16 GHz Maximum difference in MHz between frequency counter and 6759A	________MHz
c. 18-26.5 GHz Band 1.(e) 8.	Frequency = 22 GHz Maximum difference in MHz between frequency counter and 6759A	________MHz
3-17 RF Level Calibration This calibration is performed using an automatic test system. Contact WILTRON Customer Service at (408) 778–2000 for further information.		

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-18 ALC Slope Adjustment This calibration is required for the ≤2 GHz level detector and for the >2 GHz level detector.		
c. 0.01-2 GHz Band 2.(e) 2.(g) 2.(i) 5.	F1 = 0.01 GHz F2 = 2 GHz <Shift> TRIGGER Code = 050 Record the resulting waveform	 Draw Waveform Flatness for the 0.01-2 GHz Band
c. 2-26.5 GHz Band 2.(e) 2.(g) 2.(i) 5.	F1 = 2 GHz F2 = 26.5 GHz <Shift> TRIGGER Code = 051 Record the resulting waveform	 Draw Waveform Flatness for the 2-26.5 GHz Band

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-19 AM Sensitivity Calibration		
This calibration is required for each installed frequency band:		
d. 0.01-2 GHz Band		
2.(d)	Frequency = 1.1 GHz	
8.	Measure and Record AM PK(+)	________%
8.	Measure and record AM PK(–)	________%
8.	Calculate and record average	________%
d. 2-8 GHz Band		
2.(d)	Frequency = 5 GHz	
8.	Measure and Record AM PK(+)	________%
8.	Measure and record AM PK(–)	________%
8.	Calculate and record average	________%
d. 8-12.4 GHz Band		
2.(d)	Frequency = 10 GHz	
8.	Measure and Record AM PK(+)	________%
8.	Measure and record AM PK(–)	________%
8.	Calculate and record average	________%
d. 12.4-18 GHz Band		
2.(d)	Frequency = 16 GHz	
8.	Measure and Record AM PK(+)	________%
8.	Measure and record AM PK(–)	________%
8.	Calculate and record average	________%
d. 18-26.5 GHz Band		
2.(d)	Frequency = 22 GHz	
8.	Measure and Record AM PK(+)	________%
8.	Measure and record AM PK(–)	________%
8.	Calculate and record average	________%
3-20 AM Meter Calibration		
c. Meter Calibration		
2.(d)	Frequency = 1.1 GHz	
d. Meter Verification		
2.(c)	Frequency = 1.1 GHz	
2.(f)	Measure and record AM DEPTH	________%

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-21 FM Sensitivity Calibration This calibration is required for each installed frequency band:		
d. 0.01-2 GHz Band 2.(d) 8.	Frequency = 1.1 GHz Record the Waveform Null	Draw Waveform Null
d. 2-8 GHz Band 2.(d) 8.	Frequency = 5 GHz Record the Waveform Null	Draw Waveform Null
d. 8-12.4 GHz Band 2.(d) 8.	Frequency = 10 GHz Record the Waveform Null	Draw Waveform Null
d. 12.4-18 GHz Band 2.(d) 15.	Frequency =16 GHz Record the Waveform Null	Draw Waveform Null

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-21 FM Sensitivity Calibration (Continued)		
d. 18-26.5 GHz Band 2.(d) 8.	Frequency = 22 GHz Record the Waveform Null	Draw Waveform Null
3-22 FM Flatness Calibration This calibration is required for each installed frequency band:		
d. 0.01-2 GHz Band 2.(d) 10.	Frequency = 1.1 GHz Record the Waveform	Draw Waveform
b. 2-8 GHz Band 2.(d) 10.	Frequency = 5 GHz Record the Waveform	Draw Waveform
d. 8-12.4 GHz Band 2.(d) 10.	Frequency = 10 GHz Record the Waveform	Draw Waveform

CALIBRATION/ADJUSTMENT PROCEDURE STEP	CALIBRATION/ADJUSTMENT CONDITIONS	MEASURED VALUE
3-21 FM Sensitivity Calibration (Continued)		
d. 12.4-18 GHz Band 2.(d) 10.	Frequency = 16 GHz Record the Waveform	Draw Waveform
d. 18-26.5 GHz Band 2.(d) 10.	Frequency = 22 GHz Record the Waveform	Draw Waveform
3-23 FM Meter Calibration		
c. Meter Calibration Follow Procedure Steps c.1 through c.7		
d. Meter Verification 2.(c)	Measure FM Deviation	________kHz

SECTION V
PARTS LISTS

CONTENTS

Paragraph	Description	Page
5-1	INTRODUCTION	5-3
5-2	PARTS-ORDERING INFORMATION	5-3
5-3	VENDOR INFORMATION	5-3
5-4	ABBREVIATIONS	5-3
5-5	ORGANIZATION OF PARTS LISTS	5-3

Table 5-1. Vendor and Vendor FSCM Number Cross-Reference List

VENDOR	FSCM NO.	VENDOR	FSCM NO.
Airco	N/L	Intersil	32293
Allen-Bradley	01121	Kemet	N/L
Alpha	23365	Lenox-Fugel	24759
Amp	00779	Linear Technology	N/L
Analog Devices	24355	Lumex	N/L
Arco	N/L	MEPCO	19701
Aromat	61529	Micropower	N/L
Augat	91506	Mini Circuits	N/L
Beckman	60771	Monsanto	N/L
Belden	70903	MOT	N/L
Bell	N/L	Motorola	50012
Berg	N/L	Murata/Erie	72982
Berg-Du Pont	N/L	Nichicon	N/L
Bourns	08116	NSC	N/L
Burr-Brown	13919	Omron	N/L
Cal-R	92114	Panasonic	N/L
Cambion	N/L	Plessy	N/L
Central Labs	N/L	Precision Monolithic	N/L
Centre Engineering	51642	RCA	N/L
CDI	57518	RF Monolithic, Inc.	N/L
Chicago Switch	N/L	RMC	N/L
Circuit Assembly	52072	Samtec	55322
Corcom	N/L	Semtech	14099
Cornell-Dubilier	N/L	Signetics	N/L
Corning	N/L	Siliconix	17865
Crystek Crystal	N/L	Solid State Devices	N/L
Dallas Semiconductor	N/L	Sprague	N/L
Delevan	N/L	Squires	60386
Electrocube	14752	Supertex, Inc.	N/L
Electromotive	72915	Sussco (ARCO)	N/L
Elmenco	N/L	Teka Products	N/L
Erie	72982	Texas Instruments	01295
Ferroxcube	N/L	TRW	N/L
FSC	N/L	Ultex	N/L
Fujitsu	61271	Vermont Precision	55710
G.E.	N/L	Verospeed	N/L
Hamlin Inc.	27011	West Coast Magnetics	12042
Hitachi	N/L	Western Thermistor	N/L
IMB	27556	Winchester	81312
Intel	34649	Xicor	N/L
		3M	N/L

SECTION V
PARTS LISTS

5-1 INTRODUCTION

This section provides parts lists for the 67XXA Series Swept Frequency Synthesizers. The parts lists are divided into four groups:

- Printed circuit board (PCB) parts (Tables 5-4 thru 5-34)
- Options and accessories (Tables 5-35 thru 5-39)
- Major assembly parts (Figures 5-1 thru 5-9)
- Microwave deck components (Figure 5-10)

5-2 PARTS-ORDERING INFORMATION

Parts may be ordered from your local WILTRON representative or directly from the factory.

WILTRON Company
490 Jarvis Drive
Morgan Hill, CA 95037-2809

Telephone: 408-778-2000
TWX: 285227 WILTRON MH
FAX: 408-778-0239

When ordering, give complete information including the model and serial number of the instrument, the full part description, the WILTRON part number, and the quantity required.

5-3 VENDOR INFORMATION

Table 4-1 on the facing page provides a cross-reference list of vendors and their associated FSCM number. Vendors without FSCM numbers are marked with an "N/L" (No Listing).

5-4 ABBREVIATIONS

Common abbreviations used in the parts list descriptions are defined in Table 5-2.

5-5 ORGANIZATION OF PARTS LISTS

Table 5-3 is an index of the parts lists for all major assembly groups, PCBs, options/accessories, and microwave deck components of the 67XXA series synthesizers.

All PCBs listed in Table 5-3 are replaceable assemblies. The microwave deck components that are replaceable are listed in Table 5-40.

Table 5-2. Common Abbreviations Used in the Parts List

Abbreviation	Description	Abbreviation	Description
A	Ampere, Assembly	N	Not Assigned
B	Fan	P	Pin, Plug
C	Capacitor	PCB	Printed Circuit Board
CC	Carbon Composition	Q	Transistor
CER	Ceramic	R	Resistor
CR	Diode	RN	Resistor Network
DS	Display Indicator	S	Switch
E	Miscellaneous Electrical Part	SI	Silicon
F	Female	SW	Switch
FF	Flip Flop	T	Transformer
FXD	Fixed	TANT	Tantalum
HDR	Header	TP	Test Point
J	Jack	U	Integrated Circuit, Micro- (10^{-6})
K	Kilo (10^3), Relay	UF	Micro Farad (μF)
L	Inductor	UH	Micro Henry (μH)
LCD	Liquid Crystal Display	V	Volt
LED	Light Emitting Diode	VR	Voltage Regulator
M	Male, Meg- (10^6)	W	Watt, Wire Jumper
MF	Metal Film	Y	Crystal
MH	Milli Henry (mH)		

Table 5-3. Organization of Parts Lists

Table/Figure	PCB Assembly Name	Wiltron Part Number	Page
	Printed Circuit Boards (PCBs)		
Table 5-4	A1 Front Panel	6700-D-31701-3 (Rev. C)	5-5
Table 5-5	A2 Front Panel Control	6700-D-31702-3 (Rev. H)	5-8
Table 5-6	A3 Coarse Loop Mixer	6700-C-31703-3 (Rev. C)	5-10
Table 5-7	A4 Coarse Loop Oscillator	6700-D-31704-3 (Rev. D)	5-12
Table 5-8	A5 Reference Oscillator	6700-D-31705-3 (Rev. F)	5-14
Table 5-9	A6 Coarse Loop Divider	6700-D-31706-3 (Rev. F)	5-16
Table 5-10	A7 Reference Divider	6700-C-31707-3 (Rev. F)	5-19
Table 5-11	A8 Serial I/O	6700-D-31708-3 (Rev. D)	5-21
Table 5-12	A9 Fine Loop Oscillator	6700-C-31709-3 (Rev. E)	5-22
Table 5-13	A10 Reference Buffer	6700-C-31710-3 (Rev. E)	5-25
Table 5-14	A11 Fine Loop Divider	6700-D-31711-3 (Rev. G)	5-27
Table 5-15	A12 YIG Phase Detector	6700-D-31712-3 (Rev. E)	5-29
Table 5-16	A13 Pulse Generator	6700-D-31713-3 (Rev. K)	5-31
Table 5-17	A15 ALC	6700-D-31715-5 (Rev. M)	5-35
Table 5-18	A16 FM	6700-D-31716-3 (Rev. G)	5-43
Table 5-19	A17 Analog Instruction	6700-D-31717-3 (Rev. H)	5-48
Table 5-20	A18 2-8.4 GHz YIG Driver	6700-D-31718-4 (Rev. B)	5-53
Table 5-21	A18 2-8.4 GHz YIG Driver	6700-D-31718-9 (Rev. B)	5-54
Table 5-22	A19 8-12.4 GHz YIG Driver	6700-D-31718-5 (Rev. B)	5-55
Table 5-23	A20 12.4-20 GHz YIG Driver	6700-D-31718-6 (Rev. B)	5-56
Table 5-24	A21 20-26.5 GHz YIG Driver	6700-D-31718-7 (Rev. B)	5-57
Table 5-25	A21 18-26.5 GHz YIG Driver	6700-D-31718-8 (Rev. B)	5-58
Table 5-26	YIG Driver Common Parts	N/A	5-59
Table 5-27	A22 Regulator Interface	6700-D-31722-3 (Rev. F)	5-63
Table 5-28	A23 Microprocessor	6700-D-31723-3 (Rev. H)	5-65
Table 5-29	A24 GPIB	6700-D-31724-3 (Rev. C)	5-67
Table 5-30	A25 Switching Power Supply	6700-D-31725-3 (Rev. J)	5-68
Table 5-31	A26 Line Filter	6700-D-31726-3 (Rev. B)	5-72
Table 5-32	A27 Aux I/O	6700-D-31727-3 (Rev. C)	5-73
Table 5-33	A28 Motherboard	6700-D-31828-3 (Rev. A)	5-74
Table 5-34	A29 Rear Panel Interface	6700-D-31729-3 (Rev. H)	5-76
	Options and Accessories		
Table 5-35	Option 1 – Rack Mount Kit with Slides	N/A	5-82
Table 5-36	Option 2A – 110 dB Attenuator	N/A	5-82
Table 5-37	Option 2B – 90 dB Attenuator	N/A	5-82
Table 5-38	Option 2C – 110 dB Attenuator	N/A	5-82
Table 5-39	Option 9K – Rear Panel K Connector	N/A	5-82
	Major Assembly Illustrated Parts		
Fig. 5-1	Top Assembly	N/A	5-83
Fig. 5-2	Front Panel Assembly	N/A	5-84
Fig. 5-3	Basic Frame Assembly	N/A	5-85
Fig. 5-4	PCB Mechanical Assembly	N/A	5-86
Fig. 5-5	Pull-Out PCBs	N/A	5-87
Fig. 5-6	Cabling to Digital Housing	N/A	5-87
Fig. 5-7	Frame Assembly, Bottom View	N/A	5-88
Fig. 5-8	Rear Panel Assembly	N/A	5-89
Fig. 5-9	Rear Panel, Exploded View	N/A	5-90
	Microwave Deck Parts		
Fig. 5-10	Microwave Deck Parts	N/A	5-92
Table 5-40	Typical 67XXA Microwave Deck Parts	N/A	5-93

Table 5-4. A1 Front Panel PCB (6700-D-31701-3; Rev. C) Parts List (Page 1 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-37	12	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C2	250-41	1	CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C3	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR2	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
DS1	15-32	44	INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS2	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS3	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS4	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS5	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS6	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS7	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS8	15-31	4	INDICATOR,LED,RED	SSL-LX20465RD	LUMEX
DS9	15-31		INDICATOR,LED,RED	SSL-LX20465RD	LUMEX
DS10	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS11	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS12	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS13	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS14	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS15	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS16	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS17	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS18	15-31		INDICATOR,LED,RED	SSL-LX20465RD	LUMEX
DS19	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS20	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS21	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS22	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS23	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS24	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS25	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS26	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS27	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS28	15-33	1	INDICATOR,LED,GREEN	SSL-LX20465GD	LUMEX
DS29	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS30	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS31	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS32	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS33	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS34	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS35	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS36	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS37	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS38	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS39	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS40			NOT ASSIGNED		
DS41			NOT ASSIGNED		
DS42	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS43	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS44	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS45	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX

Table 5-4. A1 Front Panel PCB (6700-D-31701-3; Rev. C) Parts List (Page 2 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
DS46	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS47	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS48	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS49	15-32		INDICATOR,LED,YELLOW	SSL-LX20465YD	LUMEX
DS50	15-31		INDICATOR,LED,RED	SSL-LX20465RD	LUMEX
DS51	B30539-1	1	DISPLAY,LCD,7 SEGMENT	7128-313-465	HAMLIN INC.
DS52	B30537-1	1	DISPLAY,LCD,7 SEGMENT	7126-313-465	HAMLIN INC.
DS53	B30538-1	1	DISPLAY,LCD,7 SEGMENT	7127-313-465	HAMLIN INC.
L1	310-53	1	INDUCTOR,FXD,47UH,5%	1537-60	DELEVAN
P1	803-30	4	RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P2	803-30		RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P3	803-30		RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P4	803-30		RIBBON CABLE ASSY	IDMD-13-D-4-R	SAMTEC
P5	551-420	1	CONNECTOR,HEADER,PCB MNT RT	65521-102	BERG
Q1	20-2N3906	1	TRANSISTOR,PNP,2N3906,SI	2N3906	MOTOROLA
R1	110-2.32K-1	2	RESISTOR,FXD,MF,2.32K,1%,0.25W	SMA-4-2.32K	CORNING
R2	110-2.32K-1		RESISTOR,FXD,MF,2.32K,1%,0.25W	SMA-4-2.32K	CORNING
R3	110-221-1	5	RESISTOR,FXD,MF,221,1%,0.25W	SMA-4-221	CORNING
R4	110-221-1		RESISTOR,FXD,MF,221,1%,0.25W	SMA-4-221	CORNING
R5	110-221-1		RESISTOR,FXD,MF,221,1%,0.25W	SMA-4-221	CORNING
R6	110-221-1		RESISTOR,FXD,MF,221,1%,0.25W	SMA-4-221	CORNING
R7	110-221-1		RESISTOR,FXD,MF,221,1%,0.25W	SMA-4-221	CORNING
R8	110-1K-1	1	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R9	110-3.83K-1	1	RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4-3.83K	CORNING
R10	110-215-1	1	RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
RN1	123-14	6	RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN2	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN3	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN4	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN5	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
RN6	123-14		RESISTOR,NETWORK,MF,7X220,2%	408A221	AB
SW1	430-131	51	SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW2	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW3	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW4	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW5	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW6	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW7	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW8	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW9	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW10	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW11	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW12	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW13	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW14	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW15	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW16	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW17	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW18			NOT ASSIGNED		
SW19	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW20	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW21	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW22	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW23			NOT ASSIGNED		
SW24	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW25	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW26	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW27	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW28	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW29	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS

Table 5-4. A1 Front Panel PCB (6700-D-31701-3; Rev. C) Parts List (Page 3 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
SW30	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW31	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW32	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW33	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW34	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW35	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW36	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW37	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW38	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW39	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW40	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW41	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW42	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW43	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW44	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW45	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW46	430-159	1	SWITCH,PUSH-PUSH,PC VERT	K40351AA	CENTRALABS
SW47	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW48	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW49	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW50	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW51	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW52	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
SW53	430-131		SWITCH,PUSH BUTTON	K40141AA	CENTRALABS
U1	54-41	6	IC,TTL,74LS374,OCTAL,D FF	DM74LS374N	NSC
U2	54-41		IC,TTL,74LS374,OCTAL,D FF	DM74LS374N	NSC
U3	54-41		IC,TTL,74LS374,OCTAL,D FF	DM74LS374N	NSC
U4	54-41		IC,TTL,74LS374,OCTAL,D FF	DM74LS374N	NSC
U5	54-41		IC,TTL,74LS374,OCTAL,D FF	DM74LS374N	NSC
U6	54-41		IC,TTL,74LS374,OCTAL,D FF	DM74LS374N	NSC
U7	54-341	5	IC,CMOS,FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U8	54-341		IC,CMOS,FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U9	54-341		IC,CMOS,FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U10	54-341		IC,CMOS,FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL
U11	54-340	1	IC,CMOS,4049,HEX BUFFER/CONV	CD4049AE	RCA
U12	54-341		IC,CMOS,FOUR DIGIT DISPLAY	ICM7211AMIPL	INTERSIL

Table 5-5. A2 Front Panel Control PCB (6700-D-31702-3; Rev. H) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	250-42	4	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C2	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C3	230-37	29	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C19	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C20	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C23	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C24	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C25	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C26	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C27	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C28	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C29	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C30	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C31	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C32	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C33	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1	10-1N758A	2	DIODE,ZENER,1N758A,10V,5%	1N758A	MOTOROLA
CR2	10-1N758A		DIODE,ZENER,1N758A,10V,5%	1N758A	MOTOROLA
CR3	10-1N751A	2	DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR4	10-FD300	4	DIODE RECTIFIER,IN3595,125V,4A	IN3595	SOLID STATE DEVICES
CR5	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	IN3595	SOLID STATE DEVICES
CR6	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	IN3595	SOLID STATE DEVICES
CR7	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	IN3595	SOLID STATE DEVICES
CR8	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR9	10-1N755A	2	DIODE,ZENER,1N755A,7.5V,5%	1N755A	MOTOROLA
CR10	10-1N755A		DIODE,ZENER,1N755A,7.5V,5%	1N755A	MOTOROLA
J1	553-216	4	SOCKET,RIBBON CABLE HEADER	SD-113-T-2	SAMTEC
J2	553-216		SOCKET,RIBBON CABLE HEADER	SD-113-T-2	SAMTEC
J3	553-216		SOCKET,RIBBON CABLE HEADER	SD-113-T-2	SAMTEC
J4	553-216		SOCKET,RIBBON CABLE HEADER	SD-113-T-2	SAMTEC
J5	551-206	2	CONNECTOR,HDR,PC MNT RT ANGL	65521-103	BERG
J6	551-206		CONNECTOR,HDR,PC MNT RT ANGL	65521-103	BERG
L1	310-89	2	INDUCTOR,FIXED,1.9uH @ 50mHz	VK200 10/3B	FERROXCUBE
L2	310-89		INDUCTOR,FIXED,1.9uH @ 50mHz	VK200 10/3B	FERROXCUBE
L3	310-98	1	INDUCTOR,FXD,1mH,10%	1537-744	DELEVAN
P1	551-645	1	CONNECTOR,HEADER,1 ROW-0.10"	68015-112	BERG
P2	551-552	2	CONNECTOR HEADER,1 ROW-0.10"	68016-104	BERG
R1	110-10K-1	3	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R2	110-100K-1	1	RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R3	110-100-1	8	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R4	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R5	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R6	110-5.11K-1	2	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING

Table 5-5. A2 Front Panel Control PCB (6700-D-31702-3; Rev. H) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R7	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R8	110-5.49K-1	1	RESISTOR,FXD,MF,5.49K,1%,0.25W	SMA-4-5.49K	CORNING
R9	110-2.55K-1	1	RESISTOR,FXD,MF,2.55K,1%,0.25W	SMA-4-2.55K	CORNING
R10	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R11	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R12	110-1.96K-1	2	RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R13	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R14	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R15	157-1K	1	RESISTOR,TRIM,CER,1K,10%,20T	89PR1K	BECKMAN
R16	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R17	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R18	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R19	110-100-1	1	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R20	110-4.75K-1	1	RESISTOR,FXD,MF,4.75K,1%,0.25W	SMA-4-4.75K	CORNING
R21	110-499-1	1	RESISTOR,FXD,MF,499,1%,0.25W	SMA-4-499	CORNING
R22	110-4.64K-1	2	RESISTOR,FXD,MF,4.64K,1%,0.25W	SMA-4-4.64K	CORNING
R23	110-4.64K-1		RESISTOR,FXD,MF,4.64K,1%,0.25W	SMA-4-4.64K	CORNING
RN1	123-9	3	RESISTOR,NETWORK,MF,9X10K,2%	410A103	AB
RN2	123-9		RESISTOR,NETWORK,MF,9X10K,2%	410A103	AB
RN3	123-9		RESISTOR,NETWORK,MF,9X10K,2%	410A103	AB
U1	54-518	2	IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INST.
U2	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INST.
U3	54-528	3	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INST.
U4	54-510	1	IC,CMOS,74HC04,HEX	SN74HC04N	TEXAS INST.
U5	54-508	1	IC,CMOS,74HC02,QUAD 2-INPUT	SN74HC02N	TEXAS INST.
U6	54-515	2	IC,CMOS,74HC148,SINGLE	SN74HC148N	TEXAS INST.
U7	54-528		IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INST.
U8	54-528		IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INST.
U9	54-515		IC,CMOS,74HC148,SINGLE	SN74HC148N	TEXAS INST.
U10	54-519	1	IC,CMOS,74HC165,8 BIT SERIAL	SN74HC165N	TEXAS INST.
U11	54-513	1	IC,CMOS,74HC74,DUAL D-TYPE	SN74HC74N	TEXAS INST.
U12	54-339	14	IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U13	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U14	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U15	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U16	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U17	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U18	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U19	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U20	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U21	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U22	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U23	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U24	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U25	54-339		IC,CMOS,4054,INDIVIDUAL LCD	CD4054BE	RCA
U26	50-DG200BA	1	IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U27	50-9	1	IC,OP AMP,LF356,SINGLE	LF356N	NSC
U28	54-376	2	IC,OP-AMP,OP27EJ,SINGLE,25uV	OP27EJ	PRECISION MONOLITHIC
U29	54-376		IC,OP-AMP,OP27EJ,SINGLE,25uV	OP27EJ	PRECISION MONOLITHIC

Table 5-6. A3 Coarse Loop Mixer PCB (6700-D-31703-3; Rev. C) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1			NOT ASSIGNED		
C2	220-100	2	CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C3	250-42	3	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C4	230-37	6	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	220-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD15FD101J03	CORNELL DUBILIER
C6	220-330	2	CAPACITOR,FXD,MICA,330PF,5%,50V	CD15FD331JO3	CORNELL DUBILIER
C7	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	220-330		CAPACITOR,FXD,MICA,330PF,5%,50V	CD15FD331JO3	CORNELL DUBILIER
C10	220-30	1	CAPACITOR,FXD,MICA,30PF,5%,500V	CD15ED300JO3	CORNELL DUBILIER
C11	220-51	1	CAPACITOR,FXD,MICA,51PF,5%,500V	CD15ED510J03	CORNELL DUBILIER
C12	220-15	1	CAPACITOR,FXD,MICA,15PF,5%,500V	CMO5D150J03	ARCO/SOSHIN
C13	230-30	3	CAPACITOR,FXD,CER,1000PF,+80/-20V	BGP.001,500V,+80-20	RMC
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	230-30		CAPACITOR,FXD,CER,1000PF,+80/-20V	BGP.001,500V,+80-20	RMC
C16	220-130	1	CAPACITOR,FXD,MICA,130PF,5%,50V	CD15FD131JO3	CORNELL DUBILIER
C17	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C19	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C20	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C21	230-30		CAPACITOR,FXD,CER,1000PF,+80/-20V	BGP.001,500V,+80-20	RMC
L1	310-57	2	INDUCTOR,FXD,0.15UH,10%	1025-00	DELEVAN
L2	310-82	2	INDUCTOR,FIXED,0.10UH,10%	551-5172-09	CAMBION
L3	310-82		INDUCTOR,FIXED,0.10UH,10%	551-5172-09	CAMBION
L4	310-57		INDUCTOR,FXD,0.15UH,10%	1025-00	DELEVAN
P1	551-539	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-004	BERG
Q1	20-2N5179	6	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q2	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q3	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q4	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q5	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q6	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
R1	110-61.9-1	2	RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4 OR C4	CORNING
R2	110-249-1	1	RESISTOR,FXD,MF,249,1%,0.25W	SMA-4	CORNING
R3	110-68.1-1	1	RESISTOR,FXD,MF,68.1,1%,0.25W	SMA-4 OR C4	CORNING
R4	110-6.19K-1	1	RESISTOR,FXD,MF,6.19K,1%,0.25W	SMA-4	CORNING
R5	110-681-1	2	RESISTOR,FXD,MF,681,1%,0.25W	SMA-4	CORNING
R6	110-619-1	2	RESISTOR,FXD,MF,619,1%,0.25W	SMA-4	CORNING
R7	110-619-1		RESISTOR,FXD,MF,619,1%,0.25W	SMA-4	CORNING
R8	110-147-1	2	RESISTOR,FXD,MF,147,1%,0.25W	SMA-4 OR C4	CORNING
R9	110-36.5-1	1	RESISTOR,FXD,MF	SMA-4	CORNING
R10	110-147-1		RESISTOR,FXD,MF,147,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-178-1	2	RESISTOR,FXD,MF,178,1%,0.25W	SMA- 4 OR C4	CORNING
R12	110-48.7-1	1	RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-61.9-1		RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4 OR C4	CORNING
R14	110-2.15K-1	1	RESISTOR,FXD,MF,2.15K,1%,0.25W	SMA-4	CORNING
R15	110-332-1	3	RESISTOR,FXD,MF,332,1%,0.25W	SMA-4	CORNING
R16	110-332-1		RESISTOR,FXD,MF,332,1%,0.25W	SMA-4	CORNING
R17	110-332-1		RESISTOR,FXD,MF,332,1%,0.25W	SMA-4	CORNING
R18	110-71.5-1	1	RESISTOR,FXD,MF,71.5,1%,0.25W	SMA-4 OR C4	CORNING
R19	110-4.87K-1	1	RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4	CORNING
R20	110-715-1	1	RESISTOR,FXD,MF,715,1%,0.25W	SMA-4	CORNING
R21	110-1K-1	1	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R22	110-82.5-1	1	RESISTOR,FXD,MF,82.5,1%,0.25W	SMA-4 OR C4	CORNING
R23	110-4.22K-1	2	RESISTOR,FXD,MF,4.22K,1%,0.25W	SMA-4	CORNING
R24	110-3.83K-1		RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4	CORNING
R25	110-562-1	3	RESISTOR,FXD,MF,562,1%,0.25W	SMA-4	CORNING
R26	110-562-1		RESISTOR,FXD,MF,562,1%,0.25W	SMA-4	CORNING
R27	110-178-1		RESISTOR,FXD,MF,178,1%,0.25W	SMA4 OR C4	CORNING
R28	110-681-1		RESISTOR,FXD,MF,681,1%,0.25W	SMA-4	CORNING

Table 5-6. A3 Coarse Loop Mixer PCB (6700-D-31703-3; Rev. C) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R29	110-4.22K-1		RESISTOR,FXD,MF,4.22K,1%,0.25W	SMA-4	CORNING
R30	110-3.83K-1		RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4	CORNING
R31	110-121-1	1	RESISTOR,FXD,MF,121,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-383-1	1	RESISTOR,FXD,MF,383,1%,0.25W	SMA-4	CORNING
R33	110-562-1		RESISTOR,FXD,MF,562,1%,0.25W	SMA-4	CORNING
R34	110-44.2-1	1	RESISTOR,MF,1/4W,1%	SMA-4	CORNING
U1	60-26	1	MIXER,DOUBLE BALANCE,0.5-500MH	SRA-1	MINI CIRCUIT

Table 5-7. A4 Coarse Loop Oscillator PCB (6700-D-31704-3; Rev. D) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	223-15	1	CAPACITOR,FXD,MICA,15PF,5%,500V	M04CD150JO3	ARCO/SOSHIN
C2	230-37	4	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C3	223-91	2	CAPACITOR,FXD,MICA,91PF,5%,500V	DM10D910J0100WV4CR	ELECTROMOTIVE
C4	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	223-91		CAPACITOR,FXD,MICA,91PF,5%,500V	DM10D910J0100WV4CR	ELECTROMOTIVE
C7	223-10	1	CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C8	223-100	5	CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C9	223-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C10	223-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C11	250-42	9	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C12			NOT ASSIGNED		
C13	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C14	223-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C15	223-50	1	CAPACITOR,FXD,MICA,50PF,5%,500V	DM 10E500J	ELMENCO
C16	223-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C17	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C18	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C19	240-38	1	CAPACITOR,VAR,0.8-8PF,500V	27295	CDI
C20	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C21	230-49	2	CAPACITOR,FXD,.022uF,100V	200-100-X7R-223K	CENTRE ENG
C22	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C23	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C24	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C25	230-61	1	CAPACITOR,FXD,560pF,+/-5%	200-100-NPO-561J	CENTRE ENG
C26	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-58	1	CAPACITOR,FXD,270pF,+/-5%	200-100-NPO-271J	CENTRE ENG
C28	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C29	230-49		CAPACITOR,FXD,.022uF,100V	200-100-X7R-223K	CENTRE ENG
CR1	10-47	2	DIODE,VARACTOR	DVH6730-13	ALPHA
CR2	10-47		DIODE,VARACTOR	DVH6730-13	ALPHA
CR3	10-1N4446	2	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR4	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR5	10-FD300	3	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR6	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR7	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
L1	310-34	6	INDUCTOR,FXD,0.33UH,20%	1537-04	DELEVAN
L2	310-34		INDUCTOR,FXD,0.33UH,20%	1537-04	DELEVAN
L3	310-34		INDUCTOR,FXD,0.33UH,20%	1537-04	DELEVAN
L4	310-34		INDUCTOR,FXD,0.33UH,20%	1537-04	DELEVAN
L5	310-34		INDUCTOR,FXD,0.33UH,20%	1537-04	DELEVAN
L6			NOT ASSIGNED		
L7	310-34		INDUCTOR,FXD,0.33UH,20%	1537-04	DELEVAN
L8	310-53	2	INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L9	310-53		INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L10	310-109	1	INDUCTOR,FXD,470uH,10%	1025-84	DELEVAN
L11	310-110	1	INDUCTOR,FXD,560uH,10%	1025-86	DELEVAN
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
Q1	20-2N5179	2	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q2	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q3	20-44	1	TRANSISTOR,NPN,SINGLE	NE41635	NEC
R1	110-2.05K-1	1	RESISTOR,FXD,MF,2.05K,1%,0.25W	SMA-4	CORNING
R2	110-15.4K-1	2	RESISTOR,FXD,MF,15.4K,1%,0.25W	SMA-4	CORNING
R3	110-1.40K-1	2	RESISTOR,FXD,MF,1.40K,1%,0.25W	SMA-4	CORNING
R4	110-1.54K-1	2	RESISTOR,FXD,MF,1.54K,1%,0.25W	SMA-4	CORNING
R5	110-15.4K-1		RESISTOR,FXD,MF,15.4K,1%,0.25W	SMA-4	CORNING
R6	110-1.40K-1		RESISTOR,FXD,MF,1.40K,1%,0.25W	SMA-4	CORNING
R7	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4	CORNING
R8	110-365-1	1	RESISTOR,FXD,MF,365,1%,0.25W	SMA-4	CORNING
R9	110-100K-1	2	RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4	CORNING

Table 5-7. A4 Coarse Loop Oscillator PCB (6700-D-31704-3; Rev. D) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R10	110-316-1	1	RESISTOR,FXD,MF,316,1%,0.25W	SMA-4	CORNING
R11	110-3.01K-1	1	RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4	CORNING
R12	110-442-1		RESISTOR,FXD,MF,442,1%,0.25W	SMA-4	CORNING
R13	110-10-1	1	RESISTOR,FXD,MF,10,1%,0.25W	SMA-4 OR C4	CORNING
R14	110-442-1	2	RESISTOR,FXD,MF,442,1%,0.25W	SMA-4	CORNING
R15	110-215-1	1	RESISTOR,FXD,MF,215,1%,0.25W	SMA-4	CORNING
R16	110-3.16K-1	4	RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4	CORNING
R17	110-3.16K-1		RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4	CORNING
R18	110-51.1-1	2	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R19	110-3.16K-1		RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4	CORNING
R20	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R21	110-3.16K-1		RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4	CORNING
R22	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R23	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R24	110-1.96K-1	1	RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4	CORNING
R25	110-1.54K-1		RESISTOR,FXD,MF,1.54K,1%,0.25W	SMA-4	CORNING
R26	110-1.47K-1	2	RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4	CORNING
R27	110-1.47K-1		RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4	CORNING
R28	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4	CORNING
R29	110-6.19K-1	1	RESISTOR,FXD,MF,6.19K,1%,0.25W	SMA-4	CORNING
TP1	702-17	2	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	50-30	1	IC,OP AMP,5532A,DUAL,300K OHM	NE5532N	SIGNETICS
W1	800-13	0	WIRE,BUSS,22AWG	8021	BELDEN
W2	800-13		WIRE,BUSS,22AWG	8021	BELDEN

Table 5-8. A5 Reference Oscillator PCB (6700-D-31705-3; Rev. F) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1			NOT ASSIGNED		
C2			NOT ASSIGNED		
C3	250-41	6	CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C4	230-65	2	CAPACITOR,FXD,1500pF,+/-5%	200-100-NPO-152J	CENTRE ENG
C5	230-65		CAPACITOR,FXD,1500pF,+/-5%	200-100-NPO-152J	CENTRE ENG
C6	250-41		CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C7	250-41		CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C8	230-37	3	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	240-37	1	CAPACITOR,VAR,0.6-4.5PF,500V	27275	CDI
C10			NOT ASSIGNED		
C11	223-3	3	CAPACITOR,FXD,MICA,3PF,0.5PF,5V	CD10CD030D03	CORNELL DUBILIER
C12	223-3		CAPACITOR,FXD,MICA,3PF,0.5PF,5V	CD10CD030D03	CORNELL DUBILIER
C13			NOT ASSIGNED		
C14	223-27	1	CAPACITOR,FXD,MICA,27PF,5%,500V	CD10ED270JO3	CORNELL DUBILIER
C15	223-3		CAPACITOR,FXD,MICA,3PF,0.5PF,5V	CD10CD030D03	CORNELL DUBILIER
C16	230-30	2	CAPACITOR,FXD,CER,1000PF,+80/-20	BGP.001,500V,+80-20	RMC
C17	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C18			NOT ASSIGNED		
C19			NOT ASSIGNED		
C20			NOT ASSIGNED		
C21	230-30		CAPACITOR,FXD,CER,1000PF,+80/-20	BGP.001,500V,+80-20	RMC
C22	223-100	2	CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C23	223-10	3	CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C24	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C25	223-100		CAPACITOR,FXD,MICA,100PF,5%,50V	CD10FD101J03	CORNELL DUBILIER
C26	230-11	1	CAPACITOR,FXD,CER,0.01UF,+80/-20	TCP-R01	ARCO/SOSHIN
C27	223-91	1	CAPACITOR,FXD,MICA,91PF,5%,500V	DM10D910J0100WV4CR	ELECTROMOTIVE
C28	230-55	4	CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C29	230-39	4	CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C30	230-55		CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C31	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C32	230-55		CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C33	230-52	1	CAPACITOR,FDX,15pF,+/-5%	150-100-NPO-150J	CENTRE ENG
C34	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C35	230-55		CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C36			NOT ASSIGNED		
C37			NOT ASSIGNED		
C38			NOT ASSIGNED		
C39			NOT ASSIGNED		
C40			NOT ASSIGNED		
C41	250-41		CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C42	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C43	250-42	2	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C44	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C45	223-10		CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C46	223-10		CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C47	250-41		CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C48	250-41		CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C49	230-51	1	CAPACITOR,FDX,3.3pF,+/-.025	150-100-NPO-339C	CENTRE ENG
CR1	10-1N4446	5	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR2	10-1N752A	1	DIODE,ZENER,1N752A,5.6V,5%	1N752A	MOTOROLA
CR3	10-47	1	DIODE,VARACTOR	DVH6730-13	ALPHA
CR4	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR5	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR6	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR7	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
L1	310-53	1	INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L2	310-45	2	INDUCTOR,FXD,100.0UH,5%	1315-12J	AIRCO
L3	310-45		INDUCTOR,FXD,100.0UH,5%	1315-12J	AIRCO

Table 5-8. A5 Reference Oscillator PCB (6700-D-31705-3; Rev. F) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
Q1	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q2	20-44	1	TRANSISTOR,NPN,SINGLE	NE41635	NEC
Q3	20-2N5179	4	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q4	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q5	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q6	20-2N3694	1	TRANSISTOR,NPN,2N3694,SI,GEN P	MPS3694-18	MOTOROLA
Q7	20-2N4249	1	TRANSISTOR,PNP,2N4249,SI,LOW N	MPS4249-18	MOTOROLA
R1	110-10K-1	1	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R2	110-3.16K-1	2	RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4	CORNING
R3	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R4	110-3.16K-1		RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4	CORNING
R5	110-110K-1	2	RESISTOR,FXD,MF,110K,1%,0.25W	SMA-4	CORNING
R6	110-110K-1		RESISTOR,FXD,MF,110K,1%,0.25W	SMA-4	CORNING
R7	110-100-1	2	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R8	110-2.05K-1	2	RESISTOR,FXD,MF,2.05K,1%,0.25W	SMA-4	CORNING
R9	110-3.83K-1	1	RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4	CORNING
R10			NOT ASSIGNED		
R11	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R12	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R13	110-13.3K-1	1	RESISTOR,FXD,MF,13.3K,1%,0.25W	SMA-4	CORNING
R14	110-7.5K-1	1	RESISTOR,FXD,MF,7.5K,1%,0.25W	SMA-4	CORNING
R15	110-5.11-1	1	RESISTOR,FXD,MF,5.11,1%,0.25W	SMA-4	CORNING
R16	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4	CORNING
R17	110-1.69K-1	1	RESISTOR,FXD,MF,1.69K,1%,0.25W	SMA-4	CORNING
R18	110-1.07K-1	1	RESISTOR,FXD,MF,1.07K,1%,0.25W	SMA-4	CORNING
R19	110-2.05K-1		RESISTOR,FXD,MF,2.05K,1%,0.25W	SMA-4	CORNING
R20	110-15.4K-1	1	RESISTOR,FXD,MF,15.4K,1%,0.25W	SMA-4	CORNING
R21	110-1.54K-1	1	RESISTOR,FXD,MF,1.54K,1%,0.25W	SMA-4	CORNING
R22	109-180-5	1	RESISTOR,FXD,MF,180,5%,0.12W	C3 180OHM 5%	CORNING
R23	109-2K-5	2	RESISTOR,FXD,MF,2K,5%,0.12W	C3 2K 5%	CORNING
R24	109-510-5	2	RESISTOR,FXD,MF,510,5%,0.12W	C3 470 5%	CORNING
R25	109-1K-5	2	RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R26	109-16K-5	2	RESISTOR,FXD,MF,16K,5%,0.12W	C3 16K 5%	CORNING
R27	109-24-5	1	RESISTOR,FXD,MF,24,5%,0.125W	CMF-50	DALE RESISTOR
R28	109-330-5	1	RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R29	109-100-5	1	RESISTOR,FXD,MF,100,1%,0.12W	C3 100 OHM 5%	CORNING
R30	109-750-5	1	RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R31	109-2.2K-5	1	RESISTOR,FXD,MF,2.2K,5%,0.12W	C3 2.2K 5%	CORNING
R32	110-51.1-1	1	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R33	109-2K-5		RESISTOR,FXD,MF,2K,5%,0.12W	C3 2K 5%	CORNING
R34	109-510-5		RESISTOR,FXD,MF,510,5%,0.12W	C3 470 5%	CORNING
R35	109-1K-5		RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R36	109-16K-5		RESISTOR,FXD,MF,16K,5%,0.12W	C3 16K 5%	CORNING
R37	157-100-A	1	RESISTOR,TRIM,CER,100OHM,10%	68WR100	BECKMAN
R38	110-750-1	2	RESISTOR,FXD,MF,750,1%,0.25W	SMA-4	CORNING
R39	110-750-1		RESISTOR,FXD,MF,750,1%,0.25W	SMA-4	CORNING
U1	54-376	1	IC,OP-AMP,OP27EJ,SINGLE,25uV	OP27EJ	PRECISION MONOLITHIC
Y1	A9855	1	SAW RESONATOR ELEMENT,500MHZ	RS1003P	RF MONOLITHIC

Table 5-9. A6 Coarse Loop Divider PCB (6700-D-31706-3; Rev. F) Parts List (Page 1 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-39	17	CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C2	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C3	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C4	250-105	1	CAPACITOR,FXD,ALUM,10UF,-10/+7	513D106M050JA4	SPRAGUE
C5	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C6	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C7	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C8	250-42A	10	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C9	250-19A	1	CAPACITOR,FXD,TANT,1UF,10%,35V	196D-105X9035HA1	SPRAGUE
C10	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C11	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C12	230-64	2	CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C13	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C14	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C15	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C16	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C17			NOT ASSIGNED		
C18	230-47	1	CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C19	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C20	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C21	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C22	250-107	1	CAPACITOR,FXD,ALUM,47UF,-10/+7	476RAR035A	ILLINOIS CAP
C23	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C24	230-59	2	CAPACITOR,FXD,390pF,+/-5%	200-100-NPO-391J	CENTRE ENG
C25	230-59		CAPACITOR,FXD,390pF,+/-5%	200-100-NPO-391J	CENTRE ENG
C26	230-56	2	CAPACITOR,FXD,120pF,+/-5%	150-100-NPO-121J	CENTRE ENG
C27	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C28	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C29	230-56		CAPACITOR,FXD,120pF,+/-5%	150-100-NPO-121J	CENTRE ENG
C30			NOT ASSIGNED		
C31			NOT ASSIGNED		
C32			NOT ASSIGNED		
C33			NOT ASSIGNED		
C34			NOT ASSIGNED		
C35			NOT ASSIGNED		
C36	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C37			NOT ASSIGNED		
C38	230-76	12	CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C39	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C40	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C41	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C42	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C43	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C44	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C45	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C46	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C47	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C48	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C49	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C50	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C51	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C52	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C53	230-76		CAPACITOR,FXD,CER,1200PF,1%NPO	200-100-NPO-122F	CENTRE ENG
C54	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C55	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C56	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C57	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
CR1	10-1N4446	1	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR2	10-4	5	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR3	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA

Table 5-9. A6 Coarse Loop Divider PCB (6700-D-31706-3; Rev. F) Parts List (Page 2 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
CR4	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR5	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
L1	310-53	3	INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L2	310-43	2	INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
L3	310-43		INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
L4			NOT ASSIGNED		
L5	310-53		INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L6	310-53		INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
P2	551-539	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-004	BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q2	20-2N3904	2	TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q3	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
R1	110-6.19-1	1	RESISTOR,FXD,MF,6.19,1%,0.25	RN55D 6.19 OHM 1%	VERMONT PRECISION
R2	110-51.1-1	2	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R3	110-3.32K-1	1	RESISTOR,FXD,MF,3.32K,1%,0.25W	SMA-4	CORNING
R4	110-1.21K-1	1	RESISTOR,FXD,MF,1.21K,1%,0.25W	SMA-4	CORNING
R5	110-10-1	1	RESISTOR,FXD,MF,10,1%,0.25W	SMA-4 OR C4	CORNING
R6	110-82.5-1	1	RESISTOR,FXD,MF,82.5,1%,0.25W	SMA-4 OR C4	CORNING
R7	110-42.2-1	1	RESISTOR,FXD,MF,42.2,1%,0.25W	SMA-4	CORNING
R8	110-1K-1	6	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R9	110-2.37K-1	1	RESISTOR,FXD,MF,2.37K,1%,0.25W	SMA-4	CORNING
R10	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4	CORNING
R11	110-487-1	2	RESISTOR,FXD,MF,487,1%,0.25W	SMA-4	CORNING
R12	110-487-1		RESISTOR,FXD,MF,487,1%,0.25W	SMA-4	CORNING
R13	110-4.42K-1	2	RESISTOR,FXD,MF,4.42K,1%,0.25W	SMA-4	CORNING
R14	110-4.42K-1		RESISTOR,FXD,MF,4.42K,1%,0.25W	SMA-4	CORNING
R15	110-178-1	1	RESISTOR,FXD,MF,178,1%,0.25W	SMA4 OR C4	CORNING
R16	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R17	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R18	110-20.5K-1	1	RESISTOR,FXD,MF,20.5K,1%,0.25W	SMA-4	CORNING
R19	110-24.9K-1	1	RESISTOR,FXD,MF,24.9K,1%,0.25W	SMA-4	CORNING
R20	110-3.01K-1	2	RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4	CORNING
R21	110-100-1	8	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R22	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R23	110-2.94K-1	1	RESISTOR,FXD,MF,2.94K,1%,0.25W	SMA-4	CORNING
R24-R42			NOT ASSIGNED		
R43	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R44	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R45	113-665-0.5	4	RESISTOR,FXD,MF,665,0.5%,0.125W	RN55C	VERMONT PRECISION
R46	113-665-0.5		RESISTOR,FXD,MF,665,0.5%,0.125W	RN55C	VERMONT PRECISION
R47	113-332-0.5	4	RESISTOR,FXD,MF,332,0.5%,0.125W	RN55C	VERMONT PRECISION
R48	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R49	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R50	110-205-1	2	RESISTOR,FXD,MF,205,1%,0.25W	SMA-4	CORNING
R51	110-3.83K-1	2	RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4	CORNING
R52	113-332-0.5		RESISTOR,FXD,MF,332,0.5%,0.125W	RN55C 332 OHM .5%	VERMONT PRECISION
R53	113-332-0.5		RESISTOR,FXD,MF,332,0.5%,0.125W	RN55C 332 OHM .5%	VERMONT PRECISION
R54	113-165-0.5	1	RESISTOR,FXD,MF,165,0.5%,0.125W	RN55C 165 OHM .5%	VERMONT PRECISION
R55	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R56	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R57	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R58	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4	CORNING
R59	113-665-0.5		RESISTOR,FXD,MF,665,0.5%,0.125W	RN55C 665 OHM .5%	VERMONT PRECISION
R60	113-665-0.5		RESISTOR,FXD,MF,665,0.5%,0.125W	RN55C 665 OHM .5%	VERMONT PRECISION
R61	113-332-0.5		RESISTOR,FXD,MF,332,0.5%,0.125W	RN55C 332 OHM .5%	VERMONT PRECISION
R62	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R63	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R64	110-205-1		RESISTOR,FXD,MF,205,1%,0.25W	SMA-4	CORNING
R65	110-3.83K-1		RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4	CORNING

Table 5-9. A6 Coarse Loop Divider PCB (6700-D-31706-3; Rev. F) Parts List (Page 3 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R66	110-68.1-1	2	RESISTOR,FXD,MF,68.1,1%,0.25W	SMA-4 OR C4	CORNING
R67	110-68.1-1		RESISTOR,FXD,MF,68.1,1%,0.25W	SMA-4 OR C4	CORNING
R68	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
TP1	702-17	5	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	54-512	1	IC,CMOS,74HC14,HEX	SN74HC14N	TEXAS INSTRUMENTS
U2	54-518	2	IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U3	54-558	2	IC,TTL,74S169,4 BIT UP/DOWN	SN74169N	TEXAS INSTRUMENTS
U4	54-557	1	IC,TTL,74S20,DUAL,4 INPUT NAND	SN74S20N	TEXAS INSTRUMENTS
U5	54-353	1	IC,TTL,74S74,DUAL,D-TYPE POSITIVE	SN74S74N	TEXAS INSTRUMENTS
U6	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U7	54-74167	1	IC,TTL,74167,DECADE RATE MULTIPLIER	DM74167N	NSC
U8	54-558		IC,TTL,74S169,4 BIT UP/DOWN	SN74169N	TEXAS INSTRUMENTS
U9	54-349	1	IC,TTL,74LS283,SINGLE,4 BIT	SN74LS283N	TEXAS INSTRUMENTS
U10	54-198	1	IC,ECL,MC12009,DUAL MOD PRESCALER	MC12009P	MOTOROLA
U16	54-74LS196	1	IC,TTL,74LS196,DECADE COUNTER	74LS196PC	FSC
U17	54-74LS112	1	IC,TTL,74LS112,DUAL,JK FLIP FLOP	74LS112PC	FSC
U18	54-74LS00	1	IC,TTL,74LS00,QUAD,2 INPUT NAND	SN74LS00P	MOTOROLA
U19	54-503	1	IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
VR1	54-MC7805CP	1	IC,VOLTAGE REGULATOR,7805,5V	340T-5	NSC

Table 5-10. A7 Reference Divider PCB (6700-D-31707-3; Rev. F) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-67	2	CAPACITOR,FXD,CER,33pf,5%,100V	150-100-NPO-330J	CENTRE ENG
C2	230-39	1	CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C3	230-67		CAPACITOR,FXD,CER,33pf,5%,100V	150-100-NPO-330J	CENTRE ENG
C4	230-37	11	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5			NOT ASSIGNED		
C6			NOT ASSIGNED		
C7			NOT ASSIGNED		
C8			NOT ASSIGNED		
C9	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-49	2	CAPACITOR,FXD,.022uF,100V	200-100-X7R-223K	CENTRE ENG
C14	230-64	2	CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C15	230-49		CAPACITOR,FXD,.022uF,100V	200-100-X7R-223K	CENTRE ENG
C16	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10	RPE122104M100V	MURATA/ERIE
C17	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C18	230-60	1	CAPACITOR,FXD,470pF,+/-5%	200-100-NPO-471J	CENTRE ENG
C19	230-58	2	CAPACITOR,FXD,270pF,+/-5%	200-100-NPO-271J	CENTRE ENG
C20	230-58		CAPACITOR,FXD,270pF,+/-5%	200-100-NPO-271J	CENTRE ENG
C21	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C23	250-42	3	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C24	250-41	1	CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C25	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C26	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-47	1	CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C28	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C30	230-52	1	CAPACITOR,FDX,15pF,+/-5%	150-100-NPO-150J	CENTRE ENG
C31	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C32	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1			NOT ASSIGNED		
CR2			NOT ASSIGNED		
CR3			NOT ASSIGNED		
CR4	10-1N4446	3	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR5	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR6	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR7	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR8	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q2			NOT ASSIGNED		
Q3	20-2N3906	1	TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q4	20-2N2222A	2	TRANSISTOR,NPN,2N2222A,SI,MED-	2N2222A	MOTOROLA
Q5	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED-	2N2222A	MOTOROLA
Q6	20-2N3694	1	TRANSISTOR,NPN,2N3694,SI,GEN P	MPS3694-18	MOTOROLA
Q7	20-2N2907A	1	TRANSISTOR,PNP,2N2907A,SI,MED-	2N2907A	MOTOROLA
Q8	20-2N3904	1	TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
R1	109-43-5	2	RESISTOR,FXD,MF,43,5%,0.12W	CMF-50	DALE RESISTOR
R2	109-43-5		RESISTOR,FXD,MF,43,5%,0.12W	CMF-50	DALE RESISTOR
R3	109-75-5	1	RESISTOR,FXD,MF,75,1%,0.12W	CMF-50	DALE RESISTOR
R4	110-2K-1	1	RESISTOR,FXD,MF,2K,1%,0.25W	SMA-4	CORNING
R5	110-787-1	1	RESISTOR,FXD,MF,787,1%,0.25W	SMA-4	CORNING
R6	110-147-1	1	RESISTOR,FXD,MF,147,1%,0.25W	SMA-4 OR C4	CORNING
R7	109-120-5	1	RESISTOR,FXD,MF,120,5%,0.12W	C3 120 OHM 5%	CORNING
R8			NOT ASSIGNED		
R9	110-316-1	1	RESISTOR,FXD,MF,316,1%,0.25W	SMA-4	CORNING
R10	110-100-1	5	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R11	109-51-5	1	RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R12	110-51.1-1	5	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-10. A7 Reference Divider PCB (6700-D-31707-3; Rev. F) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R13	110-2.74K-1	1	RESISTOR,FXD,MF,2.74K,1%,0.25W	SMA-4	CORNING
R14	110-511-1	2	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4	CORNING
R15	109-5.1K-5	2	RESISTOR,FXD,MF,5.1K,5%,0.12W	C3 5.1K 5%	CORNING
R16	109-5.1K-5		RESISTOR,FXD,MF,5.1K,5%,0.12W	C3 5.1K 5%	CORNING
R17	109-300-5	1	RESISTOR,FXD,MF,300,5%,0.12W	C3 300 OHM 5%	CORNING
R18	110-10K-1	3	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R19	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R20	110-1K-1	4	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R21	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R22	110-681-1	1	RESISTOR,FXD,MF,681,1%,0.25W	SMA-4	CORNING
R23	110-5.11K-1	4	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4	CORNING
R24	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R25	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4	CORNING
R26	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R27	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R28	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R29	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4	CORNING
R30	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R31	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-16.2-1	1	RESISTOR,FXD,MF,16.2,1%,0.25W	SMA-4 OR C4	CORNING
R33	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4	CORNING
R34	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4	CORNING
R35	110-17.8K-1	2	RESISTOR,FXD,MF,17.8K,1%,0.25W	SMA-4	CORNING
R36	110-17.8K-1		RESISTOR,FXD,MF,17.8K,1%,0.25W	SMA-4	CORNING
R37	110-4.02K-1	2	RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4	CORNING
R38	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R39	110-4.02K-1		RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4	CORNING
R40	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R41	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R42	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R43	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
TP1	702-17	3	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	54-547	1	IC,ECL,SP8680B,SINGLE,10/11	SP8680B	PLESSY
U2	54-328	1	IC,TTL.74S02,QUAD,2 INPUT NOR	74S02	FSC
U3	54-329	3	IC,TTL,74S112,DUAL,JK EDGE-TRIG	SN74S112N	TEXAS INSTRUMENTS
U4	54-329		IC,TTL,74S112,DUAL,JK EDGE-TRIG	SN74S112N	TEXAS INSTRUMENTS
U5	54-74132	1	IC,TTL,74132,QUAD,NAND SCHMITT	DM74132N	NSC
U6	54-329		IC,TTL,74S112,DUAL,JK EDGE-TRIG	SN74S112N	TEXAS INSTRUMENTS
U7	54-376	1	IC,OP-AMP,OP27EJ,SINGLE,25uV	OP27EJ	PRECISION MONOLITHIC
VR1	54-MC7805CP	1	IC,VOLTAGE REGULATOR,7805,5V	340T-5	NSC

Table 5-11. A8 Serial I/O PCB (6700-D-31708-3; Rev. D) Parts List (Page 1 of 1)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1			NOT ASSIGNED		
C2			NOT ASSIGNED		
C3			NOT ASSIGNED		
C4			NOT ASSIGNED		
C5			NOT ASSIGNED		
C6			NOT ASSIGNED		
C7			NOT ASSIGNED		
C8			NOT ASSIGNED		
C9	230-61	1	CAPACITOR,FXD,560pF,+/-5%	200-100-NPO-561J	CENTRE ENG
C10	230-37	13	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-71	1	CAPACITOR,FIXED,CER,68pf,5%	150-100-NPO-680J	CENTR ENG
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C14	250-105	1	CAPACITOR,FXD,ALUM,10UF,-10/+7	513D106M050JA4	SPRAGUE
C15	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
L1	310-53	1	INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
R1	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R2	110-499-1	1	RESISTOR,FXD,MF,499,1%,0.25W	SMA-4	CORNING
R3	110-4.75K-1	1	RESISTOR,FXD,MF,4.75K,1%,0.25W	SMA-4	CORNING
R4	110-24.9-1	1	RESISTOR,MF,1/4W,1%	SMA-4	CORNING
R5	110-200-1	3	RESISTOR,FXD,MF,200,1%,0.25W	SMA-4	CORNING
R6	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R7	110-511-1	2	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4	CORNING
R8	110-200-1		RESISTOR,FXD,MF,200,1%,0.25W	SMA-4	CORNING
R9	110-200-1		RESISTOR,FXD,MF,200,1%,0.25W	SMA-4	CORNING
R10	110-51.1-1	2	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R11	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R4			NOT ASSIGNED		
R5			NOT ASSIGNED		
R6			NOT ASSIGNED		
R7			NOT ASSIGNED		
R8			NOT ASSIGNED		
R9			NOT ASSIGNED		
R10			NOT ASSIGNED		
R11			NOT ASSIGNED		
R12	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4	CORNING
RN1	123-34	1	RESISTOR,NETWORK,MF,5X470,2%	MSP10A03-471G	DALE
RN2	123-15	2	RESISTOR,NETWORK,MF,7X4.7K,2%	4308R-101-472	BOURNS
RN3	123-15		RESISTOR,NETWORK,MF,7X4.7K,2%	4308R-101-472	BOURNS
T1	320-88	4	TRANSFORMER,RF,FIX,200-500KHZ		WEST COAST MAGNETICS
T2	320-88		TRANSFORMER,RF,FIX,200-500KHZ		WEST COAST MAGNETICS
T3	320-88		TRANSFORMER,RF,FIX,200-500KHZ		WEST COAST MAGNETICS
T4	320-88		TRANSFORMER,RF,FIX,200-500KHZ		WEST COAST MAGNETICS
U1	54-528	1	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U2	54-512	1	IC,CMOS,74HC14,HEX	SN74HC14N	TEXAS INSTRUMENTS
U3	54-514	1	IC,CMOS,74HC125,QUAD	SN74HC125N	TEXAS INSTRUMENTS
U4	54-513	1	IC,CMOS,74HC74,DUAL D-TYPE	SN74HC74N	TEXAS INSTRUMENTS
U5	54-523	1	IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U6	54-458	2	IC,ANALOG SWITCH,DG 508,8	DG508CJ	SILICONIX
U7	54-365	1	IC,CMOS,7555,TIMER	ICM7555IPA	INTERSIL
U8	54-535	1	IC,CMOS,74HC393,DUAL,4BIT	SN74HC393N	TEXAS INSTRUMENTS
U9	54-532	1	IC,CMOS,74HC299, 8 BIT	CD74HC299F	RCA
U10	54-336	1	IC,CMOS,509,4 CHANNEL DIFFER	DG509 ACJ	SILICONIX
U11	54-519	1	IC,CMOS,74HC165,8 BIT SERIAL	SN74HC165N	TEXAS INSTRUMENTS
U12	54-458		IC,ANALOG SWITCH,DG 508,8	DG508CJ	SILICONIX

Table 5-12. A9 Fine Loop Oscillator PCB (6700-D-31709-3; Rev. E) Parts List (Page 1 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1			NOT ASSIGNED		
C2			NOT ASSIGNED		
C3			NOT ASSIGNED		
C4			NOT ASSIGNED		
C5			NOT ASSIGNED		
C6			NOT ASSIGNED		
C7	230-66	1	CAPACITOR,FXD,CER,0.22UF,10%	CW30C224K	CENTRALAB
C8	250-42A	11	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C9	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C10	230-37	7	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	250-143	7	CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C12	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C13	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C16			NOT ASSIGNED		
C17	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C18	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C19	230-60	2	CAPACITOR,FXD,470pF,+/-5%	200-100-NPO-471J	CENTRE ENG
C20	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C21	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C22	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C23	230-70	2	CAPACITOR,FIXED,CER,27pf,5%	150-100-NPO-270J	CENTRE ENG
C24	230-60		CAPACITOR,FXD,470pF,+/-5%	200-100-NPO-471J	CENTRE ENG
C25	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C26	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C27	230-70		CAPACITOR,FIXED,CER,27pf,5%	150-100-NPO-270J	CENTRE ENG
C28	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C29	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C30	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C31	230-77	1	CAPACITOR,FXD,CER,3300pF,5%	300-100-NPO-332J	CENTRE ENGIN
C32	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1	10-FD300	8	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR2			NOT ASSIGNED		
CR3	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR4	10-1N823	1	DIODE,ZENER,1N823,6.2V,5%	1N823	MOTOROLA
CR5			NOT ASSIGNED		
CR6			NOT ASSIGNED		
CR7			NOT ASSIGNED		
CR8			NOT ASSIGNED		
CR9			NOT ASSIGNED		
CR10			NOT ASSIGNED		
CR11	10-72	2	DIODE,VARACTOR,ZC804B	ZC804B	MSI ELECTORN
CR12	10-72		DIODE,VARACTOR,ZC804B	ZC804B	MSI ELECTORN
CR13			NOT ASSIGNED		
CR14	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR15	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
J1			NOT ASSIGNED		
J2			NOT ASSIGNED		
J3	551-547	1	CONNECTOR HEADER,1 ROW-0.10"	68001-103	BERG
L1	310-36	2	INDUCTOR,FXD,0.33UH,20%	1025-8	DELEVAN
L2	310-36		INDUCTOR,FXD,0.33UH,20%	1025-8	DELEVAN
L3	310-72	2	INDUCTOR,FXD,0.047UH,+-10%	551-5172-05-02-00	CAMBION
L4	310-72		INDUCTOR,FXD,0.047UH,+-10%	551-5172-05-02-00	CAMBION
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
Q1	20-56	1	TRANSISTOR,JFET,J310	J310	SILICONIX
Q2	20-2N5179	5	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q3	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q4	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q5	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA

Table 5-12. A9 Fine Loop Oscillator PCB (6700-D-31709-3; Rev. E) Parts List (Page 2 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
Q6	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
R1	109-33-5	6	RESISTOR,FXD,MF,33,5%,0.12W	C3 33OHM 5%	CORNING
R2	109-33-5		RESISTOR,FXD,MF,33,5%,0.12W	C3 33OHM 5%	CORNING
R3	109-33-5		RESISTOR,FXD,MF,33,5%,0.12W	C3 33OHM 5%	CORNING
R4	109-33-5		RESISTOR,FXD,MF,33,5%,0.12W	C3 33OHM 5%	CORNING
R5	109-33-5		RESISTOR,FXD,MF,33,5%,0.12W	C3 33OHM 5%	CORNING
R6	109-33-5		RESISTOR,FXD,MF,33,5%,0.12W	C3 33OHM 5%	CORNING
R7	110-3.01K-1	6	RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R8	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R9	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R10	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R11	110-13.7K-1	2	RESISTOR,FXD,MF,13.7K,1%,0.25W	SMA-4-13.7K	CORNING
R12	110-1.78K-1	1	RESISTOR,FXD,MF,1.78K,1%,0.25W	SMA-4-1.78K	CORNING
R13	109-1K-5	6	RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R14	109-1K-5		RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R15	110-11.8K-1	2	RESISTOR,FXD,MF,11.8K,1%,0.25W	SMA-4-11.8K	CORNING
R16	110-1.96K-1	1	RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R17	110-1.47K-1	1	RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4-1.47K	CORNING
R18	110-2.37K-1	1	RESISTOR,FXD,MF,2.37K,1%,0.25W	SMA-4-2.37K	CORNING
R19	110-10K-1	1	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R20	110-5.11K-1	2	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R21	110-1.27K-1	1	RESISTOR,FXD,MF,1.27K,1%,0.25W	SMA-4-1.27K	CORNING
R22	110-4.02K-1	2	RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R23	110-90.9K-1	1	RESISTOR,FXD,MF,90.9K,1%,0.25W	SMA-4-90.9K	CORNING
R24	110-6.04K-1	1	RESISTOR,FXD,MF,6.04K,1%,0.25W	SMA-4-6.04K	CORNING
R25	110-30.1K-1	1	RESISTOR,FXD,MF,30.1K,1%,0.25W	SMA-4-30.1K	CORNING
R26	110-13.7K-1		RESISTOR,FXD,MF,13.7K,1%,0.25W	SMA-4-13.7K	CORNING
R27	110-11.8K-1		RESISTOR,FXD,MF,11.8K,1%,0.25W	SMA-4-11.8K	CORNING
R28	110-41.2K-1	1	RESISTOR,FXD,MF,41.2K,1%,0.25W	SMA-4-41.2K	CORNING
R29	110-10.2K-1	1	RESISTOR,FXD,MF,10.2K,1%,0.25W	SMA-4-10.2K	CORNING
R30	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R31	110-10.5K-1	1	RESISTOR,FXD,MF,10.5K,1%,0.25W	SMA-4-10.5K	CORNING
R32	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R33	109-51-5	1	RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R34	110-316-1	1	RESISTOR,FXD,MF,316,1%,0.25W	SMA-4-316	CORNING
R35	109-750-5	3	RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R36	109-16-5	1	RESISTOR,FXD,MF,16,5%,0.12W	C3 160HM 5%	CORNING
R37	109-5.1K-5	3	RESISTOR,FXD,MF,5.1K,5%,0.12W	C3 5.1K 5%	CORNING
R38	109-3K-5	1	RESISTOR,FXD,MF,3K,5%,0.12W	C3 3K 5%	CORNING
R39	109-330-5	2	RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R40	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R41	109-110-5	2	RESISTOR,FXD,MF,110,5%,0.12W	C3 110OHM 5%	CORNING
R42	109-91-5	2	RESISTOR,FXD,MF,91,5%,0.12W	C3 91OHM 5%	CORNING
R43	109-5.1K-5		RESISTOR,FXD,MF,5.1K,5%,0.12W	C3 5.1K 5%	CORNING
R44	109-750-5		RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R45	109-36-5	1	RESISTOR,FXD,MF,36,5%,0.12W	C3 36OHM 5%	CORNING
R46	109-150-5	2	RESISTOR,FXD,MF,150,5%,0.12W	C3 150OHM 5%	CORNING
R47	109-1K-5		RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R48	109-43-5	4	RESISTOR,FXD,MF,43,5%,0.12W	CMF-50	DALE RESISTOR
R49	109-1K-5		RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R50	109-43-5		RESISTOR,FXD,MF,43,5%,0.12W	CMF-50	DALE RESISTOR
R51	109-110-5		RESISTOR,FXD,MF,110,5%,0.12W	C3 110OHM 5%	CORNING
R52	109-91-5		RESISTOR,FXD,MF,91,5%,0.12W	C3 91OHM 5%	CORNING
R53	109-5.1K-5		RESISTOR,FXD,MF,5.1K,5%,0.12W	C3 5.1K 5%	CORNING
R54	109-750-5		RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R55	109-150-5		RESISTOR,FXD,MF,150,5%,0.12W	C3 150OHM 5%	CORNING
R56	109-1K-5		RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R57	109-43-5		RESISTOR,FXD,MF,43,5%,0.12W	CMF-50	DALE RESISTOR
R58	109-1K-5		RESISTOR,FXD,MF,1K,5%,0.12W	C3 1K 5%	CORNING
R59	109-43-5		RESISTOR,FXD,MF,43,5%,0.12W	CMF-50	DALE RESISTOR

Table 5-12. A9 Fine Loop Oscillataor PCB (6700-D-31709-3; Rev. E) Parts List (Page 3 of 3)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R60	109-1.8K-5	1	RESISTOR,FXD,MF,1.8K,5%,0.12W	C3 1.8K 5%	CORNING
R61	110-71.5K-1	1	RESISTOR,FXD,MF,71.5K,1%,0.25W	SMA-4-71.5K	CORNING
R62	110-147K-1	1	RESISTOR,FXD,MF,147K,1%,0.25W	SMA-4-147K	CORNING
R63	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R64	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R65	110-19.6K-1	1	RESISTOR,FXD,MF,19.6K,1%,0.25W	SMA-4-19.6K	CORNING
R66	110-4.02K-1		RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R67	110-33.2K-1	1	RESISTOR,FXD,MF,33.2K,1%,0.25W	SMA-4-33.2K	CORNING
TP1	702-17	7	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3			NOT ASSIGNED		
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP6	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP7			NOT ASSIGNED		
TP8	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP9	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1	50-30	2	IC,OP AMP,5532A,DUAL,300K OHM	NE5532N	SIGNETICS
U2	50-30		IC,OP AMP,5532A,DUAL,300K OHM	NE5532N	SIGNETICS
U3	54-376	1	IC,OP-AMP,OP27EJ,SINGLE,25uV	OP27EJ	PRECISION MONOLITHIC
U4	50-9	1	IC,OP AMP,LF356,SINGLE	LF356N	NSC

Table 5-13. A10 Reference Buffer PCB (6700-D-31710-3; Rev. E) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	250-19	1	CAPACITOR,FXD,TANT,1UF,10%,35V	196D105X9035HE3	SPRAGUE
C2	230-66	1	CAPACITOR,FXD,CER,0.22uf,10%	CW30C224K	CENTRALAB
C3	250-42	2	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C4	230-47	10	CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C5	230-39	8	CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C6	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C7	230-47		CAPACITOR,FXD,?,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C8	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C9	230-47		CAPACITOR,FXD,?,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C10	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C11	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C12	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C13	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C14	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C15	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C16	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C17	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C18	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C19	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C20	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C21	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C22	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
CR1	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR2	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR3	10-FD300	2	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR4	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
L1	310-43	1	INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
L2	310-61	3	INDUCTOR,FXD,10UH,10%	1025-44	DELEVAN
L3	310-61		INDUCTOR,FXD,10UH,10%	1025-44	DELEVAN
L4	310-61		INDUCTOR,FXD,10UH,10%	1025-44	DELEVAN
P1	551-539	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-004	BERG
Q1	20-2N3563	5	TRANSISTOR,NPN,2N3563,SI,RF-IF	PN3563	FSC
Q2	20-2N3563		TRANSISTOR,NPN,2N3563,SI,RF-IF	PN3563	FSC
Q3	20-2N3563		TRANSISTOR,NPN,2N3563,SI,RF-IF	PN3563	FSC
Q4	20-2N3563		TRANSISTOR,NPN,2N3563,SI,RF-IF	PN3563	FSC
Q5	20-2N3563		TRANSISTOR,NPN,2N3563,SI,RF-IF	PN3563	FSC
Q6	20-2N5179	3	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q7	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q8	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q9	20-2N3906	2	TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q10	20-2N3906		TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q11	20-2N3904	2	TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q12	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
R1	110-5.11-1	1	RESISTOR,FXD,MF,5.11,1%,0.25W	RN55D 5.11 OHM 1%	VERMONT PRECISION
R2	109-51-5	9	RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R3	109-1.8K-5	1	RESISTOR,FXD,MF,1.8K,5%,0.12W	C3 1.8K 5%	CORNING
R4	109-2.2K-5	1	RESISTOR,FXD,MF,2.2K,5%,0.12W	C3 2.2K 5%	CORNING
R5	109-36-5	1	RESISTOR,FXD,MF,36,5%,0.12W	C3 36OHM 5%	CORNING
R6	109-330-5	8	RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R7	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R8	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R9	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R10	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R11	109-20-5	3	RESISTOR,FXD,MF,20,5%,0.12W	C3 20OHM 5%	CORNING
R12	109-82-5		RESISTOR,FXD,MF,82,5%,0.12W	C3,82OHM,5%	CORNING
R13	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R14	109-750-5	3	RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R15	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R16	109-30-5	5	RESISTOR,FXD,MF,30,5%,0.12W	C3 30OHM 5%	CORNING
R17	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR

Table 5-13. A10 Reference Buffer PCB (6700-D-31710-3; Rev. E) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R18	109-16-5	3	RESISTOR,FXD,MF,16,5%,0.12W	C3 16 OHM 5%	CORNING
R19	109-20-5		RESISTOR,FXD,MF,20,5%,0.12W	C3 20OHM 5%	CORNING
R20	109-82-5		RESISTOR,FXD,MF,82,5%,0.12W	CMF-50	DALE RESISTOR
R21	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R22	109-750-5		RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R23	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R24	109-30-5		RESISTOR,FXD,MF,30,5%,0.12W	C3 30OHM 5%	CORNING
R25	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R26	109-16-5		RESISTOR,FXD,MF,16,5%,0.12W	C3 16 OHM 5%	CORNING
R27	109-20-5		RESISTOR,FXD,MF,20,5%,0.12W	C3 20OHM 5%	CORNING
R28	109-82-5		RESISTOR,FXD,MF,82,5%,0.12W	CMF-50	DALE RESISTOR
R29	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R30	109-750-5		RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R31	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R32	109-30-5		RESISTOR,FXD,MF,30,5%,0.12W	C3 30OHM 5%	CORNING
R33	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
R34	109-16-5		RESISTOR,FXD,MF,16,5%,0.12W	C3 16 OHM 5%	CORNING
R35	109-330-5		RESISTOR,FXD,MF,330,5%,0.125W	C3 330 OHM 5%	CORNING
R36	109-30-5		RESISTOR,FXD,MF,30,5%,0.12W	C3 30OHM 5%	CORNING
R37	109-30-5		RESISTOR,FXD,MF,30,5%,0.12W	C3 30OHM 5%	CORNING
R38	109-2K-5	1	RESISTOR,FXD,MF,2K,5%,0.12W	C3 2K 5%	CORNING
R39	109-51-5		RESISTOR,FXD,MF,51,5%,0.12W	CMF-50	DALE RESISTOR
TP1	702-17	1	TERMINAL,EYELET	20-2137D	VEROSPEED
VR1	54-MC7805CP	1	IC,VOLTAGE REGULATOR,7805,5V	340T-5	NSC

Table 5-14. A11 Fine Loop Divider PCB (6700-D-31711-3; Rev. G) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-37	19	CAPACITOR,FXD,CER,0.1UF,20%,10V	PE122104M100V	MURATA/ERIE
C2	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	250-42	5	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C10	230-66	1	CAPACITOR,FXD,CER,0.22uf,10%	CW30C224K	CENTRALAB
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C18	230-64	4	CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C19	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C20	230-52	1	CAPACITOR,FDX,15pF,+/-5%	150-100-NPO-150J	CENTRE ENG
C21	250-58	2	CAPACITOR,FXD,TANT,68UF,10%,6V	196D686X9006KE3	SPRAGUE
C22	250-58		CAPACITOR,FXD,TANT,68UF,10%,6V	196D686X9006KE3	SPRAGUE
C23	230-47	1	CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C24	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C25	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C26	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C27	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C28-C47			NOT ASSIGNED		
C48	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C49-C52			NOT ASSIGNED		
C53	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1	10-4	1	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
L1	310-53	1	INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L2	310-43	3	INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
L3	310-43		INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
L4	310-43		INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
P2	551-539	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-004	BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q2	20-2N3904	2	TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q3	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
R1	110-16.2-1	1	RESISTOR,FXD,MF,16.2,1%,0.25W	SMA-4-16.2	CORNING
R2	110-54.9-1	1	RESISTOR,FXD,MF,54.9,1%,0.25W	SMA-4-54.9	CORNING
R3	110-1K-1	6	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R4	110-3.48K-1	1	RESISTOR,FXD,MF,3.48K,1%,0.25W	SMA-4-3.48K	CORNING
R5	110-100-1	1	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R6	110-26.1-1	1	RESISTOR,FXD,MF,26.1,1%,0.25W	SMA-4-26.1	CORNING
R7	110-464-1	2	RESISTOR,FXD,MF,464,1%,0.25W	SMA-4-464	CORNING
R8	110-464-1		RESISTOR,FXD,MF,464,1%,0.25W	SMA-4-464	CORNING
R9			NOT ASSIGNED		
R10			NOT ASSIGNED		
R11			NOT ASSIGNED		
R12			NOT ASSIGNED		
R13	110-5.36K-1	2	RESISTOR,FXD,MF,5.36K,1%,0.25W	SMA-4-5.36K	CORNING
R14	110-5.36K-1		RESISTOR,FXD,MF,5.36K,1%,0.25W	SMA-4-5.36K	CORNING
R15			NOT ASSIGNED		
R16			NOT ASSIGNED		
R17			NOT ASSIGNED		
R18			NOT ASSIGNED		
R19			NOT ASSIGNED		

Table 5-14. A11 Fine Loop Divider PCB (6700-D-31711-3; Rev. G) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R20	110-604K-1	1	RESISTOR,FXD,MF,604K,1%,0.25W	SMA-4-604K	CORNING
R21	113-7.23K-0.5	4	RESISTOR,FXD,MF,7.23K,0.5%	RN55C 7.23K .5%	VERMONT PRECISION
R22	113-7.23K-0.5		RESISTOR,FXD,MF,7.23K,0.5%	RN55C 7.23K .5%	VERMONT PRECISION
R23	113-3.61K-0.5	4	RESISTOR,FXD,MF,3.61K,0.5%	RN55C 3.61K .5%	VERMONT PRECISION
R24	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R25	110-9.53K-1	3	RESISTOR,FXD,MF,9.53K,1%,0.25W	SMA-4-9.53K	CORNING
R26	113-3.61K-0.5		RESISTOR,FXD,MF,3.61K,0.5%	RN55C 3.16K .5%	VERMONT PRECISION
R27	113-3.61K-0.5		RESISTOR,FXD,MF,3.61K,0.5%	RN55C 3.16K .5%	VERMONT PRECISION
R28	113-1.8K-0.5	3	RESISTOR,FXD,MF,1.8K,0.5%	RN55C 1.8K .5%	VERMONT PRECISION
R29	110-1.96K-1	1	RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R30	110-7.87K-1	1	RESISTOR,FXD,MF,7.87K,1%,0.25W	SMA-4-7.87K	CORNING
R31	113-2.4K-0.5	2	RESISTOR,FXD,MF,2.4K,0.5%,0.12W	RN55C,2.4K,.5%	VERMONT PRECISION
R32	113-2.4K-0.5		RESISTOR,FXD,MF,2.4K,0.5%,0.12W	RN55C,2.4K,.5%	VERMONT PRECISION
R33	113-1.21K-0.5	1	RESISTOR,FXD,MF,1.21K,0.5%	RN55C,1.21K,.5%	VERMONT PRECISION
R34	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R35	110-9.53K-1		RESISTOR,FXD,MF,9.53K,1%,0.25W	SMA-4-9.53K	CORNING
R36	113-1.8K-0.5		RESISTOR,FXD,MF,1.8K,0.5%	RN55C,1.8K,.5%	VERMONT PRECISION
R37	113-1.8K-0.5		RESISTOR,FXD,MF,1.8K,0.5%	RN5C,1.8K,.5%	VERMONT PRECISION
R38	113-909-0.5	1	RESISTOR,FXD,MF,909,0.5%	RN55C,909,.5%	VERMONT PRECISION
R39	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R40	110-19.6K-1	1	RESISTOR,FXD,MF,19.6K,1%,0.25W	SMA-4-19.6K	CORNING
R41	113-7.23K-0.5		RESISTOR,FXD,MF,7.23K,0.5%	RN55C,7.23K,.5%	VERMONT PRECISION
R42	113-7.23K-0.5		RESISTOR,FXD,MF,7.23K,0.5%	RN55C,7.23K,.5%	VERMONT PRECISION
R43	113-3.61K-0.5		RESISTOR,FXD,MF,3.61K,0.5%	RN55C,3.61K,.5%	VERMONT PRECISION
R44	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R45	110-9.53K-1		RESISTOR,FXD,MF,9.53K,1%,0.25W	SMA-4-9.53K	CORNING
R46	110-4.02K-1	1	RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R47	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R48	110-169-1	2	RESISTOR,FXD,MF,169,1%,0.25W	SMA-4-169	CORNING
R49	110-169-1		RESISTOR,FXD,MF,169,1%,0.25W	SMA-4-169	CORNING
R50			NOT ASSIGNED		
R51			NOT ASSIGNED		
R52			NOT ASSIGNED		
R53			NOT ASSIGNED		
R54	110-274-1	2	RESISTOR,FXD,MF,274,1%,0.25W	SMA-4-274	CORNING
R55	110-274-1		RESISTOR,FXD,MF,274,1%,0.25W	SMA-4-274	CORNING
R56	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R57	110-2.37K-1	1	RESISTOR,FXD,MF,2.37K,1%,0.25W	SMA-4-2.37K	CORNING
R58	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R59	110-51.1-1	1	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
U1	54-512	1	IC,CMOS,74HC14,HEX	SN74HC14N	TEXAS INSTRUMENTS
U2	54-518	2	IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U3	54-74LS196	2	IC,TTL,74LS196,DECADE COUNTER	74LS196PC	FSC
U4	54-545	1	IC,AS TTL,74AS11,TRIPLE	SN74AS11N	TEXAS INSTRUMENTS
U5	54-74LS196		IC,TTL,74LS196,DECADE COUNTER	74LS196PC	FSC
U6	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U7	54-74167	1	IC,TTL,74167,DECADE RATE MUL	DM74167N	NSC
U8	54-361	1	IC,TTL,74S196,PRESETTABLE	SN74S196N	TEXAS INSTRUMENTS
U9	54-329	2	IC,TTL,74S112,DUAL,JK EDGE-TRIGGER	SN74S112N	TEXAS INSTRUMENTS
U10	54-74LS132	1	IC,TTL,74LS132,QUAD,NAND SCHMIDT	DM74LS132N	NSC
U11	54-349	1	IC,TTL,74LS283,SINGLE,4 BIT	SN74LS283N	TEXAS INSTRUMENTS
U12	54-406	1	IC,TTL,74S197,BINARY COUNTER	SN74S197N	TEXAS INSTRUMENTS
U13	54-329		IC,TTL,74S112,DUAL,JK EDGE-TRIGGER	SN74S112N	TEXAS INSTRUMENTS
U14	54-547	1	IC,ECL,SP8680B,SINGLE,10/11	SP8680B	PLESSY
U15	54-544	1	IC,AS TTL,74AS02,QUAD	SN74AS02N	TEXAS INSTRUMENTS
U16-U18			NOT ASSIGNED		
U19	54-172	1	IC,TTL,74LS390,DUAL,DECADE COUNTER	DM74LS390N	NSC
U20	54-540	1	IC,ALS TTL,74ALS112,DUAL	74ALS112N	TEXAS INSTRUMENTS
VR1	54-MC7805CP	1	IC,VOLTAGE REGULATOR,7805,5V	340T-5	NSC

Table 5-15. A12 YIG Phase Detector PCB (6700-D-31712-3; Rev. E) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-66	1	CAPACITOR,FXD,CER,0.22uf,10%	W30C224K	CENTRE LAB
C2	250-41	1	CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C3	230-64	6	CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C4	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C5	230-37	7	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	250-77	1	CAPACITOR,FXD,CER,0.01UF,10%,1V	CK05BX103K	SPRAGUE
C7	230-52	1	CAPACITOR,FDX,15pF,+/-5%	150-100-NPO-150J	CENTRE ENG
C8			NOT ASSIGNED		
C9			NOT ASSIGNED		
C10	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C13	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C16	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C17			NOT ASSIGNED		
C18			NOT ASSIGNED		
C19			NOT ASSIGNED		
C20	223-330	4	CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
C21	223-330		CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
C22	223-43	2	CAPACITOR,FXD,MICA,43PF,5%,500V	DM 10E 430J05%300V	ELMENCO
C23	223-43		CAPACITOR,FXD,MICA,43PF,5%,500V	DM 10E 430J05%300V	ELMENCO
C24	250-42	2	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C25	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C26	223-330		CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
C27	223-330		CAPACITOR,FXD,MICA,330PF,5%,10V	CMO4FA331JO3	ARCO/SOSHIN
CR1	10-1N4446	1	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
L1	310-53	2	INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L2	310-53		INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
Q1	20-2N5179	1	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q2			NOT ASSIGNED		
Q3			NOT ASSIGNED		
Q4	20-2N2222A	2	TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q5	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q6	20-45	1	TRANSISTOR,FET,N CHANNEL ENH	VN10KM	SILICONIX
Q7	20-2N3563	2	TRANSISTOR,NPN,2N3563,SI,RF-IF	PN3563	FSC
Q8	20-2N3563		TRANSISTOR,NPN,2N3563,SI,RF-IF	PN3563	FSC
R1	109-56-5	1	RESISTOR,FXD,MF,56,5%,0.12W	C3 56OHM 5%	CORNING
R2	110-1K-1	5	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R3	110-3.48K-1	1	RESISTOR,FXD,MF,3.48K,1%,0.25W	SMA-4	CORNING
R4	109-100-5	1	RESISTOR,FXD,MF,100,1%,0.12W	CMF-50	DALE RESISTOR
R5	109-27-5	1	RESISTOR,FXD,MF,27,5%,0.12W	CMF-50	DALE RESISTOR
R6	110-200-1	1	RESISTOR,FXD,MF,200,1%,0.25W	SMA-4	CORNING
R7	110-56.2-1	1	RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4 OR C4	CORNING
R8			NOT ASSIGNED		
R9			NOT ASSIGNED		
R10			NOT ASSIGNED		
R11	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R12	110-750-1	2	RESISTOR,FXD,MF,750,1%,0.25W	SMA-4	CORNING
R13	110-348-1	1	RESISTOR,FXD,MF,348,1%,0.25W	SMA-4	CORNING
R14	110-1.07K-1	1	RESISTOR,FXD,MF,1.07K,1%,0.25W	SMA-4	CORNING
R15	110-887-1	2	RESISTOR,FXD,MF,887,1%,0.25W	SMA-4	CORNING
R16	110-301-1	2	RESISTOR,FXD,MF,301,1%,0.25W	SMA-4	CORNING
R17	110-2.43K-1	1	RESISTOR,FXD,MF,2.43K,1%,0.25W	SMA-4	CORNING
R18	110-301-1		RESISTOR,FXD,MF,301,1%,0.25W	SMA-4	CORNING
R19	110-887-1		RESISTOR,FXD,MF,887,1%,0.25W	SMA-4	CORNING
R20	110-383-1	1	RESISTOR,FXD,MF,383,1%,0.25W	SMA-4	CORNING
R21	110-681-1	1	RESISTOR,FXD,MF,681,1%,0.25W	SMA-4	CORNING

Table 5-15. A12 YIG Phase Detector PCB (6700-D-31712-3; Rev. E) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R22	110-750-1		RESISTOR,FXD,MF,750,1%,0.25W	SMA-4	CORNING
R23	110-5.11K-1	1	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4	CORNING
R24	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R25	110-4.87K-1		RESISTRO,FXD,MF,4.87K,1%,0.25W	SMA-4	CORNING
R26	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R27	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4	CORNING
R28	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4	CORNING
R29	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4	CORNING
R30	110-90.9K-1	2	RESISTOR,FXD,MF,90.9K,1%,0.25W	SMA-4	CORNING
R31	110-19.6K-1	2	RESISTOR,FXD,MF,19.6K,1%,0.25W	SMA-4	CORNING
R32	110-100-1	2	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R33	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-90.9K-1		RESISTOR,FXD,MF,90.9K,1%,0.25W	SMA-4	CORNING
R35	110-19.6K-1		RESISTOR,FXD,MF,19.6K,1%,0.25W	SMA-4	CORNING
R36	110-68.1-1	2	RESISTOR,FXD,MF,68.1,1%,0.25W	SMA-4 OR C4	CORNING
R37	110-16.2-1	1	RESISTOR,FXD,MF,16.2,1%,0.25W	SMA-4 OR C4	CORNING
R38	110-2.74K-1	2	RESISTOR,FXD,MF,2.74K,1%,0.25W	SMA-4	CORNING
R39	110-2.74K-1		RESISTOR,FXD,MF,2.74K,1%,0.25W	SMA-4	CORNING
R40	110-22.6K-1	2	RESISTOR,FXD,MF,22.6K,1%,0.25W	SMA-4	CORNING
R41	110-22.6K-1		RESISTOR,FXD,MF,22.6K,1%,0.25W	SMA-4	CORNING
R42	110-169-1	1	RESISTOR,FXD,MF,169,1%,0.25W	SMA-4 OR C4	CORNING
R43	110-51.1-1	1	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R44	110-68.1-1		RESISTOR,FXD,MF,68.1,1%,0.25W	SMA-4 OR C4	CORNING
R45	110-4.02K-1	1	RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4	CORNING
R46	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
U1	54-547	1	IC,ECL,SP8680B,SINGLE,10/11	SP8680B	PLESSY
U2	54-361	2	IC,TTL,74S196,PRESETTABLE	SN74S196N	TEXAS INSTRUMENTS
U3	54-361		IC,TTL,74S196,PRESETTABLE	SN74S196N	TEXAS INSTRUMENTS
U4	54-540	1	IC,ALS TTL,74ALS112,DUAL	74ALS112N	TEXAS INSTRUMENTS
U5	54-390	1	IC,TTL,74ALS00A,QUAD,2 INPUT	SN74ALS00AN	TEXAS INSTRUMENTS
U6	50-9	1	IC,OP AMP,LF356,SINGLE	LF356N	NSC
VR1	54-MC7805CP	1	IC,VOLTAGE REGULATOR,7805,5V	340T-5	NSC

Table 5-16. A13 Pulse Generator PCB (6700-D-31713-3; Rev. K) Parts List (Page 1 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-37	40	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C2	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	250-58	1	CAPACITOR,FXD,TANT,68UF,10%,6V	196D686X9006KE3	SPRAGUE
C7	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-55	2	CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	230-55		CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C16	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C18			NOT ASSIGNED		
C19	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C20	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C23	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C24	230-70	2	CAPACITOR,FIXED,CER,27pf,5%	150-100-NPO-270J	CENTRE ENG.
C25	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C26	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C27	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C28	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C29	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C30	230-64	8	CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C31	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C32	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C33	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C34	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C35	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C36	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C37	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C38	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C39	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C40	250-40	1	CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X002HE3	SPRAGUE
C41	250-42	2	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C42	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C43	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C44	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C45	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C46	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C47	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C48	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C49	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C50	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C51	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C52	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C53	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C54	230-64		CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C56	230-70		CAPACITOR,FIXED,CER,27pf,5%	150-100-NPO-270J	CENTRE ENG
C57	230-47	1	CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C58	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
CR1	10-1N4446	9	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR2	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR3	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL

Table 5-16. A13 Pulse Generator PCB (6700-D-31713-3; Rev. K) Parts List (Page 2 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
CR5	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR6	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR7	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR8	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR9	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR10	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR11	10-1N746A	1	DIODE,ZENER,1N746,3.3V,10%	1N746	MOTOROLA
CR12	10-4	9	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR13	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR14	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR15	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR16	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR17	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR18	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR19	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
DS1	15-5	2	INDICATOR,LED,RED	MV5774C	MONSANTO
DS2	15-5		INDICATOR,LED,RED	MV5774C	MONSANTO
L1	310-89	1	INDUCTOR,FIXED,1.9uH @ 50mHz	VK200 10/3B	FERROXCUBE
L2	310-45	1	INDUCTOR,FXD,100.0UH,5%	1315-12J	AIRCO
L3	310-57	4	INDUCTOR,FXD,0.15UH,10%	1025-00	DELEVAN
L4	310-57		INDUCTOR,FXD,0.15UH,10%	1025-00	DELEVAN
L5	310-57		INDUCTOR,FXD,0.15UH,10%	1025-00	DELEVAN
L6	310-57		INDUCTOR,FXD,0.15UH,10%	1025-00	DELEVAN
P1	551-538	1	CONNECTOR,SOCKET,1 ROW-0.150"	66947-011	BERG
Q1	20-2N4249	2	TRANSISTOR,PNP,2N4249,SI,LOW N	MPS4249-18	MOTOROLA
Q2	20-2N4249		TRANSISTOR,PNP,2N4249,SI,LOW N	MPS4249-18	MOTOROLA
Q3	20-2N4122	16	TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q4	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q5	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q6	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q7	20-2N5179	4	TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q8	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q9	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q10	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q11	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q12	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q13	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q14	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q15	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q16	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q17	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA
Q18	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q19	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q20	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q21	20-2N4122		TRANSISTOR,PNP,2N4122,SI,GEN P	PN4122	NATIONAL
Q22	20-2N5179		TRANSISTOR,NPN,2N5179,SI,HIGH	2N5179	RCA 109
Q23			NOT ASSIGNED		
Q24	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q25	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
R1	110-2.05K-1	2	RESISTOR,FXD,MF, 2.05K,1%,0.25W	SMA-4-2.05K	CORNING
R2	110-4.02K-1	2	RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R3	110-2.05K-1		RESISTOR,FXD,MF,2.05K,1%,0.25W	SMA-4-2.05K	CORNING
R4	110-4.02K-1		RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R5	110-200-1	1	RESISTOR,FXD,MF,200,1%,0.25W	SMA-4-200	CORNING
R6	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R7	110-100-1	4	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R8			NOT ASSIGNED		
R9	110-511-1	2	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R10	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R11	110-10.5K-1	1	RESISTOR,FXD,MF,10.5K,1%,0.25W	SMA-4-10.5K	CORNING

Table 5-16. A13 Pulse Generator PCB (6700-D-31713-3; Rev. K) Parts List (Page 3 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R12	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R13	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R14	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R15	110-383-1	2	RESISTOR,FXD,MF,383,1%,0.25W	SMA-4-383	CORNING
R16	110-383-1		RESISTOR,FXD,MF,383,1%,0.25W	SMA-4-383	CORNING
R17	110-51.1-1	17	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R18	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R19	110-1.78K-1	4	RESISTOR,FXD,MF,1.78K,1%,0.25W	SMA-4-1.78K	CORNING
R20	110-261-1	4	RESISTOR,FXD,MF,261,1%,0.25W	SMA-4-261	CORNING
R21	110-536-1	4	RESISTOR,FXD,MF,536,1%,0.25W	SMA-4-536	CORNING
R22	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R23	110-56.2-1	8	RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R24	110-56.2-1		RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R25	110-332-1	4	RESISTOR,FXD,MF,332,1%,0.25W	SMA-4-332	CORNING
R26	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R27	110-26.1-1	4	RESISTOR,FXD,MF,26.1,1%,0.25W	SMA-4-26.1	CORNING
R28	110-536-1		RESISTOR,FXD,MF,536,1%,0.25W	SMA-4-536	CORNING
R29	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R30	110-261-1		RESISTOR,FXD,MF,261,1%,0.25W	SMA-4-261	CORNING
R31	110-56.2-1		RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R32	110-332-1		RESISTOR,FXD,MF,332,1%,0.25W	SMA-4-332	CORNING
R33	110-56.2-1		RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R34	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R35	110-26.1-1		RESISTOR,FXD,MF,26.1,1%,0.25W	SMA-4-26.1	CORNING
R36	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R37	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R38	110-1.78K-1		RESISTOR,FXD,MF,1.78K,1%,0.25W	SMA-4-1.78K	CORNING
R39	110-169-1	1	RESISTOR,FXD,MF,169,1%,0.25W	SMA-4-169	CORNING
R40	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R41	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R42	110-1.78K-1		RESISTOR,FXD,MF,1.78K,1%,0.25W	SMA-4-1.78K	CORNING
R43	110-536-1		RESISTOR,FXD,MF,536,1%,0.25W	SMA-4-536	CORNING
R44	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R45	110-261-1		RESISTOR,FXD,MF,261,1%,0.25W	SMA-4-261	CORNING
R46	110-56.2-1		RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R47	110-56.2-1		RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R48	110-332-1		RESISTOR,FXD,MF,332,1%,0.25W	SMA-4-332	CORNING
R49	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R50	110-26.1-1		RESISTOR,FXD,MF,26.1,1%,0.25W	SMA-4-26.1	CORNING
R51	110-56.2-1		RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R52	110-536-1		RESISTOR,FXD,MF,536,1%,0.25W	SMA-4-536	CORNING
R53	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R54	110-261-1		RESISTOR,FXD,MF,261,1%,0.25W	SMA-4-261	CORNING
R55	110-332-1		RESISTOR,FXD,MF,332,1%,0.25W	SMA-4-332	CORNING
R56	110-56.2-1		RESISTOR,FXD,MF,56.2,1%,0.25W	SMA-4-56.2	CORNING
R57	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R58	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R59	110-1.78K-1		RESISTOR,FXD,MF,1.78K,1%,0.25W	SMA-4-1.78K	CORNING
R60	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R61	110-26.1-1		RESISTOR,FXD,MF,26.1,1%,0.25W	SMA-4-26.1	CORNING
R62	110-2.37K-1	1	RESISTOR,FXD,MF,2.37K,1%,0.25W	SMA-4-2.37K	CORNING
R63	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R64	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R65	110-6.49-1	1	RESISTOR,FXD,MF,6.49,1%,0.25W	RN55D,6.49, 1%	VPR
R66	110-90.9-1	2	RESISTOR,FXD,MF,402,1%,0.25W	SMA-4-90.9	CORNING
R67	110-402-1	1	RESISTOR,FXD,MF,402,1%,0.25W	SMA-4-402	CORNING
R68	110-90.9-1		RESISTOR,FXD,MF,402,1%,0.25W	SMA-4-90.9	CORNING
TP1	702-17	9	TERMINAL,EYELET	20-2137D	VEROSPEED
TP2	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP3	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED

Table 5-16. A13 Pulse Generator PCB (6700-D-31713-3; Rev. K) Parts List (Page 4 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
TP4	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP5	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP6	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP7	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP8	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
TP9	702-17		TERMINAL,EYELET	20-2137D	VEROSPEED
U1			NOT ASSIGNED		
U2	54-539	1	IC,ALS TTL,74ALS86,QUADRUPLE	SN74ALS86N	TEXAS INSTRUMENTS
U3	54-387	2	IC,TTL,74ALS08,QUAD,2 INPUT	SN74ALS08N	TEXAS INSTRUMENTS
U4	54-542	9	IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U5	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U6	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U8	54-541	2	IC,ALS TTL,74ASL151,8 INPUT	SN74ALS151N	TEXAS INSTRUMENTS
U9	54-512	1	IC,CMOS,74HC14,HEX	SN74HC14N	TEXAS INSTRUMENTS
U10	54-518	7	IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U11	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U12	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U13	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U14	54-387		IC,TTL,74ALS08,QUAD,2 INPUT	SN74ALS08N	TEXAS INSTRUMENTS
U15	54-541		IC,ALS TTL,74ASL151, 8 INPUT	SN74ALS151N	TEXAS INSTRUMENTS
U16	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U17	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U18	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U19	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U20	54-542		IC,ALS TTL,74ALS160,BCD	SN74ALS160N	TEXAS INSTRUMENTS
U21	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U22	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U24	54-552	3	IC,ALS-TTL,74ALS153,DUAL,4 LINE	SN74ALS153N	TEXAS INSTRUMENTS
U23			NOT ASSIGNED		
U25	54-538	3	IC,ALS TTL,74ALS74,DUAL	SN74ALS74N	TEXAS INSTRUMENTS
U26	54-537	1	IC,ALS TTL,74ALS38,QUADRUPLE	SN74ALS38N	TEXAS INSTRUMENTS
U27	54-538		IC,ALS TTL,74ALS74,DUAL	SN74ALS74N	TEXAS INSTRUMENTS
U28	54-538		IC,ALS TTL,74ALS74,DUAL	SN74ALS74N	TEXAS INSTRUMENTS
U29	54-324	1	IC,TTL,DUAL,DIGITAL DELAY	DDU-4-5125	DATA DELAY
U30	54-552		IC,ALS-TTL,74ALS153,DUAL,4 LINE	SN74ALS153N	TEXAS INSTRUMENTS
U31	54-552		IC,ALS-TTL,74ALS153,DUAL,4 LINE	SN74ALS153N	TEXAS INSTRUMENTS
U32	54-391	2	IC,TTL,74ALS02,QUAD,2INPUT NOR	SN74ALS02N	TEXAS INSTRUMENTS
U33			NOT ASSIGNED		
U34	54-518		IC,CMOS,74HC164,8 BIT SERIAL	SN74HC164N	TEXAS INSTRUMENTS
U35	54-391		IC,TTL,74ALS02,QUAD,2 INPUT NOR	SN74ALS02N	TEXAS INSTRUMENTS
U36	54-233	2	IC,OP AMP,CA3054	CA3054	RCA
U37	54-233		IC,OP AMP,CA3054	CA3054	RCA
VR1	54-184	1	IC,VOLTAGE REGULATOR,7905,-5V	UA7905UC	FSC

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. M) Parts List (Page 1 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-39	11	CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C2	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C3	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C4	223-56	1	CAPACITOR,FXD,MICA,56PF,5%,500V	DM10E 560J0 500V	CORNELL DUBILIER
C5	230-85	1	CAPACITOR,FXD,CER,0.33uF,10%	300-100-X7R-334K	CENTRE ENG
C6	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C7	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C8	250-58A	1	CAPACITOR,FXD,TANT,68UF,10%,6V	196D686X9006KA1	SPRAGUE
C9	250-40A	1	CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C10	250-42A	33	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C11	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C12	230-53	4	CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C13	230-53		CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C14	230-57	2	CAPACITOR,FXD,220pF	200-100-NPO-221J	CENTRE ENG
C15	230-59	1	CAPACITOR,FXD,390pF,+/-5%	200-100-NPO-391J	CENTRE ENG
C16	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C17	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C18	230-66	2	CAPACITOR,FXD,CER,0.22uf,10%	CW30C224K	CENTRALAB
C19	230-66		CAPACITOR,FXD,CER,0.22uf,10%	CW30C224K	CENTRALAB
C20	210-30	3	CAPACITOR,FXD,PEST,0.10UF,10%	ECQ-E2104KZS	PANASONIC
C21	210-30		CAPACITOR,FXD,PEST,0.10UF,10%	ECQ-E2104KZS	PANASONIC
C22	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C23	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C24	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C25	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C26	230-53		CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C27	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C28	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C29	230-53		CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C30	230-52	3	CAPACITOR,FDX,15pF,+/-5%	150-100-NPO-150J	CENTRE ENG
C31	230-52		CAPACITOR,FDX,15pF,+/-5%	150-100-NPO-150J	CENTRE ENG
C32	230-51	1	CAPACITOR,FDX,3.3pF,+/-.025	150-100-NPO-339C	CENTRE ENG
C33	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C34	230-55	2	CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C35	230-58	2	CAPACITOR,FXD,270pF,+/-5%	200-100-NPO-271J	CENTRE ENG
C36	250-39A	4	CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JA1	SPRAGUE
C37	250-39A		CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JA1	SPRAGUE
C38	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C39	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C40	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C41	230-47	4	CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C42	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C43	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C44	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C45	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C46	230-55		CAPACITOR,FXD,100pF,+/-5%	150-100-NPO-101J	CENTRE ENG
C47	230-58		CAPACITOR,FXD,270pF,+/-5%	200-100-NPO-271J	CENTRE ENG
C48	250-39A		CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JA1	SPRAGUE
C49	250-39A		CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JA1	SPRAGUE
C50	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C51	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C52	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C53	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C54	230-47		CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C55	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C56	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C57	230-62	1	CAPACITOR,FXD,680pF,+/-5%	200-100-NPO-681J	CENTRE ENG
C58	210-30		CAPACITOR,FXD,PEST,0.10UF,10%	ECQ-E2104KZS	SPRAGUE
C59	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C60	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. M) Parts List (Page 2 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C61	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C62	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C63	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C64	230-57		CAPACITOR,FXD,220pF	200-100-NPO-221J	CENTRE ENG
C65	230-74	1	CAPACITOR,FIXED,CER,5PF,5%	200-100-NPO-5R0J	CENTRE ENG
C66	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C67	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C68	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C69	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C70	230-68	1	CAPACITOR,TXD,CER,22pf,5%,100V	150-100-NPO-220J	CENTRE ENG
C71	250-41A	1	CAPACITOR,FXD,TANT,6.8pF,10%,3V	196D685X9035KA1	SPRAGUE
C72	230-60	1	CAPACITOR,FXD,470pF,+/-5%	200-100-NPO-471J	CENTRE ENG
C73	250-102	1	CAPACITOR,FXD,PCAR,0.01UF,1%,5V	RV2A103F	IMB
C74	230-52		CAPACITOR,FDX,15pF,+/-5%	150-100-NPO-150J	CENTRE ENG
C75	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C76	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C77	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C78	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C79	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C80	250-42A		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KA1	SPRAGUE
C81	250-40	1	CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X002HE3	SPRAGUE
C82	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C83	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C84	230-67	2	CAPACITOR,FXD,CER,33pF,5%,100V	150-100-NPO-330J	CENTRE
C85	230-67		CAPACITOR,FXD,CER,33pF,5%,100V	200-100-NPO-330J	CENTRE
CR1	10-FD300	9	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR2	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR3	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR4	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR5	10-11	2	DIODE,ZENER,1N750A,4.7V,5%	IN750A	FSC
CR6	10-11		DIODE,ZENER,1N750A,4.7V,5%	IN750A	FSC
CR7	10-1N751A	2	DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR8	10-1N4446	12	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR9	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR10	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR11	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR12	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR13	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR14	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR15	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR16	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR17	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR18	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR19	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR20	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR21	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR22	10-1N755A	1	DIODE,ZENER,1N755A,7.5V,5%	1N755A	MOTOROLA
CR23	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR24	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR25	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR26	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
J1	516-57	1	CONNECTOR,RF CABLE,SMB RECP	32JR111-1	SPECIALTY CO
L1	310-43	2	INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
L2	310-43		INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN 109
Q1	20-56	4	TRANSISTOR,JFET,J310	J310	SILICONIX
Q2	20-2N3904	15	TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q3	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q4	20-56		TRANSISTOR,JFET,J310	J310	SILICONIX
Q5	20-2N3906	7	TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q6	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. M) Parts List (Page 3 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
Q7	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q8	20-2N3906		TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q9	20-56		TRANSISTOR,JFET,J310	J310	SILICONIX
Q10	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q11	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q12	20-56		TRANSISTOR,JFET,J310	J310	SILICONIX
Q13	20-2N3906		TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q14	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q15	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q16	20-2N3906		TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q17	20-66	8	TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q18	20-66		TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q19	20-66		TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q20	20-66		TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q21	20-2N3906		TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q22	20-2N3906		TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q23	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q24	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q25	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q26	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q27			NOT ASSIGNED		
Q28			NOT ASSIGNED		
Q29	20-66		TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q30	20-66		TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q31	20-66		TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q32	20-66		TRANSISTOR,JFET,2N4392,SI	2N4392	SILICONIX
Q33	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q34	20-2N3906		TRANSISTOR,PNP,2N3906,SI,GEN P	2N3906	MOTOROLA
Q35	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
Q36	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN P	2N3904	MOTOROLA
R1	110-1K-1	25	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R2	110-604-1	2	RESISTOR,FXD,MF,604,1%,0.25W	SMA-4-604	CORNING
R3	110-2K-1	4	RESISTOR,FXD,MF,2K,1%,0.25W	SMA-4-2K	CORNING
R4	110-2K-1		RESISTOR,FXD,MF,2K,1%,0.25W	SMA-4-2K	CORNING
R5	110-10K-1	13	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R6	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R7	110-100-1	10	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R8	110-100K-1	6	RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R9	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R10	110-604-1		RESISTOR,FXD,MF,604,1%,0.25W	SMA-4-604	CORNING
R11	110-2K-1		RESISTOR,FXD,MF,2K,1%,0.25W	SMA-4-2K	CORNING
R12	110-2K-1		RESISTOR,FXD,MF,2K,1%,0.25W	SMA-4-2K	CORNING
R13	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R14	110-3.16K-1	3	RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4-3.16K	CORNING
R15	110-3.16K-1		RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4-3.16K	CORNING
R16	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R17	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R18	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R19	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R20	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R21	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R22	110-196K-1	1	RESISTOR,FXD,MF,196K,1%,0.25W	SMA-4-196K	CORNING
R23	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R24	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R25	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R26	110-20K-1	2	RESISTOR,FXD,MF,20K,1%,0.25W	SMA-4-20K	CORNING
R27	110-20K-1		RESISTOR,FXD,MF,20K,1%,0.25W	SMA-4-20K	CORNING
R28	110-14K-1	2	RESISTOR,FXD,MF,14K,1%,0.25W	SMA-4-14K	CORNING
R29	110-14K-1		RESISTOR,FXD,MF,14K,1%,0.25W	SMA-4-14K	CORNING
R30	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. M) Parts List (Page 4 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R31	110-1M-1	4	RESISTOR,FXD,MF,1M,1%,0.25W	SMA-4-1M	CORNING
R32	110-1M-1		RESISTOR,FXD,MF,1M,1%,0.25W	SMA-4-1M	CORNING
R33	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R34	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R35	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R36	110-953-1	2	RESISTOR,FXD,MF,953,1%,0.25W	SMA-4-953	CORNING
R37	110-3.01K-1	3	RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R38	110-6.04K-1	1	RESISTOR,FXD,MF,6.04K,1%,0.25W	SMA-4-6.04K	CORNING
R39	110-4.99K-1	5	RESISTOR,FXD,MF,4.99K,1%,0.25W	SMA-4-4.99K	CORNING
R40	110-4.02K-1	4	RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R41	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25W	SMA-4-4.99K	CORNING
R42	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R43	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R44	110-4.87K-1	9	RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R45	110-46.4K-1	2	RESISTOR,FXD,MF,46.4K,1%,0.25W	SMA-4-46.4K	CORNING
R46	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R47	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R48	110-46.4K-1		RESISTOR,FXD,MF,46.4K,1%,0.25W	SMA-4-46.4K	CORNING
R49	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R50	110-825-1	1	RESISTOR,FXD,MF,825,1%,0.25W	SMA-4-825	CORNING

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. K) Parts List (Page 5 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R51	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R52	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R53	110-4.75K-1	4	RESISTOR,FXD,MF,4.75K,1%,0.25W	SMA-4-4.75K	CORNING
R54	110-4.75K-1		RESISTOR,FXD,MF,4.75K,1%,0.25W	SMA-4-4.75K	CORNING
R55	110-215-1	4	RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R56	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R57	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R58	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R59	110-40.2-1	2	RESISTOR,FXD,MF,40.2,1%,0.25W	SMA-4-40.2	CORNING
R60	110-7.15K-1	4	RESISTOR,FXD,MF,7.15K,1%,0.25W	SMA-4-7.15K	CORNING
R61	110-1M-1		RESISTOR,FXD,MF,1M,1%,0.25W	SMA-4-1M	CORNING
R62	110-316-1	1	RESISTOR,FXD,MF,316,1%,0.25W	SMA-4-316	CORNING
R63	110-7.15K-1		RESISTOR,FXD,MF,7.15K,1%,0.25W	SMA-4-7.15K	CORNING
R64	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R65	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R66	110-7.87K-1	3	RESISTOR,FXD,MF,7.87K,1%,0.25W	SMA-4-7.87K	CORNING
R67	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R68	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R69	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R70	110-750-1	6	RESISTOR,FXD,MF,750,1%,0.25W	SMA-4-750	CORNING
R71	110-681-1	2	RESISTOR,FXD,MF,681,1%,0.25W	SMA-4-681	CORNING
R72	110-750-1		RESISTOR,FXD,MF,750,1%,0.25W	SMA-4-750	CORNING
R73	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R74	110-1.69K-1		RESISTOR,FXD,MF,1.69K,1%,0.25W	SMA-4-1.69K	CORNING
R75	110-6.81K-1	2	RESISTOR,FXD,MF,6.81K,1%,0.25W	SMA-4-6.81K	CORNING
R76	110-48.7-1	10	RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R77	157-1K-B	2	RESISTOR,TRIM,CER,1K,10%,18T	89PR1K	BECKMAN
R78	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R79	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R80	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R81	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R82	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R83	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R84	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R85	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R86	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R87	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R88	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R89	110-40.2-1		RESISTOR,MF,1/4W,1%	SMA-4-40.2	CORNING
R90	110-7.15K-1		RESISTOR,FXD,MF,7.15K,1%,0.25W	SMA-4-7.15K	CORNING
R91	110-1M-1		RESISTOR,FXD,MF,1M,1%,0.25W	SMA-4-1M	CORNING
R92	110-348-1	1	RESISTOR,FXD,MF,348,1%,0.25W	SMA-4-348	CORNING
R93	110-7.15K-1		RESISTOR,FXD,MF,7.15K,1%,0.25W	SMA-4-7.15K	CORNING
R94	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R95	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R96	110-7.87K-1		RESISTOR,FXD,MF,7.87K,1%,0.25W	SMA-4-7.87K	CORNING
R97	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R98	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R99	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R100	110-750-1		RESISTOR,FXD,MF,750,1%,0.25W	SMA-4-750	CORNING
R101	110-681-1		RESISTOR,FXD,MF,681,1%,0.25W	SMA-4-681	CORNING
R102	110-750-1		RESISTOR,FXD,MF,750,1%,0.25W	SMA-4-750	CORNING
R103	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R104	110-1.69K-1		RESISTOR,FXD,MF,1.69K,1%,0.25W	SMA-4-1.69K	CORNING
R105	110-6.81K-1		RESISTOR,FXD,MF,6.81K,1%,0.25W	SMA-4-6.81K	CORNING
R106	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R107	157-1K-B		RESISTOR,TRIM,CER,1K,10%,18T	89PR1K	BECKMAN
R108	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R109	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R110	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. K) Parts List (Page 6 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R111	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R112	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R113	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R114	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R115	110-4.75K-1		RESISTOR,FXD,MF,4.75K,1%,0.25W	SMA-4-4.75K	CORNING
R116	110-4.75K-1		RESISTOR,FXD,MF,4.75K,1%,0.25W	SMA-4-4.75K	CORNING
R117	157-20K-B	1	RESISTOR,TRIM,CER,20K,10%,18T	68XR-20K	BECKMAN
R118	110-40.2K-1	2	RESISTOR,FXD,MF,40.2K,1%,0.25W	SMA-4-40.2K	CORNING
R119	110-40.2K-1		RESISTOR,FXD,MF,40.2K,1%,0.25W	SMA-4-40.2K	CORNING
R120	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R121	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R122	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R123	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R124			NOT ASSIGNED		
R125	113-4.87K-0.1	1	RESISTOR,FXD,MF,4.87K,0.1%	RN55C,4.87K,.1%	VERMONT PRECISION
R126	113-2K-0.1	1	RESISTOR,FXD,MF,2K,0.1%	RN55C,2K,.1%	VERMONT PRECISION
R127	113-10K-0.1	1	RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R128	113-24.9K-0.1		RESISTOR,FXD,MF,24.9K,0.1%,0.1W	RN55C,24.9K,.1%	VERMONT PRECISION
R129	110-4.22K-1	1	RESISTOR,FXD,MF,4.22K,1%,0.25W	SMA-4-4.22K	CORNING
R130	110-4.02K-1		RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R131	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R132	110-2.74K-1	1	RESISTOR,FXD,MF,2.74K,1%,0.25W	SMA-4-2.74K	CORNING
R133	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R134	110-1.47K-1	1	RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4-1.47K	CORNING
R135	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R136	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R137	110-787-1	1	RESISTOR,FXD,MF,787,1%,0.25W	SMA-4-787	CORNING
R138	110-1.62K-1	4	RESISTOR,FXD,MF,1.62K,1%,0.25W	SMA-4-1.62K	CORNING
R139	110-1.62K-1		RESISTOR,FXD,MF,1.62K,1%,0.25W	SMA-4-1.62K	CORNING
R140	110-332-1	2	RESISTOR,FXD,MF,332,1%,0.25W	SMA-4-332	CORNING
R141	110-33.2-1	1	RESISTOR,FXD,MF,33.2,1%,0.25W	SMA-4-33.2	CORNING
R142	110-562-1	2	RESISTOR,FXD,MF,562,1%,0.25W	SMA-4-562	CORNING
R143	110-562-1		RESISTOR,FXD,MF,562,1%,0.25W	SMA-4-562	CORNING
R144	110-1.62K-1		RESISTOR,FXD,MF,1.62K,1%,0.25W	SMA-4-1.62K	CORNING
R145	110-1.62K-1		RESISTOR,FXD,MF,1.62K,1%,0.25W	SMA-4-1.62K	CORNING
R146	110-332-1		RESISTOR,FXD,MF,332,1%,0.25W	SMA-4-332	CORNING
R147			NOT ASSIGNED		
R148			NOT ASSIGNED		
R149	110-5.11-1	1	RESISTOR,FXD,MF,5.11,1%,0.25W	RN55D,5.11,1%	VERMONT PRECISION
R150	110-2.49K-1	4	RESISTOR,FXD,MF,2.49K,1%,0.25W	SMA-4-2.49K	CORNING
R151	110-2.49K-1		RESISTOR,FXD,MF,2.49K,1%,0.25W	SMA-4-2.49K	CORNING
R152	113-6.19K-0.1	2	RESISTOR,FIX,MF,6.19K,0.1%	RN55C,6.19K,.1%	VERMONT PRECISION
R153	110-4.87K-0.1		RESISTOR,FXD,MF,4.87K,1%,0.25W	RN55C,4.87K,.1%	VERMONT PRECISION
R154	113-6.19K-0.1		RESISTOR,FIX,MF,6.19K,0.1%	RN55C,6.19,.1%	VERMONT PRECISION
R155	113-4.87K-0.1		RESISTOR,FXD,MF,4.87K,0.1%	RN55C,4.87,.1%	VERMONT PRECISION
R156	109-22K-5	1	RESISTOR,FXD,MF,22K,5%,0.125W	SMA-4-22K	CORNING
R157	110-9.53K-1	1	RESISTOR,FXD,MF,9.53K,1%,0.25W	SMA-4-9.53K	CORNING
R158	158-2	1	RESISTOR,TRIM,CER,1K,10%,1T	A2B102	ALLEN BRADLEY
R159	110-2.49K-1		RESISTOR,FXD,MF,2.49K,1%,0.25W	SMA-4-2.49K	CORNING
R160	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R161	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R162	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25W	SMA-4-4.99K	CORNING
R163	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R164	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R165	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R166	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R167	110-4.02K-1		RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R168	110-16.2K-1	1	RESISTOR,FXD,MF,16.2K,1%,0.25W	SMA-4-16.2K	CORNING
R169	110-3.32K-1	1	RESISTOR,FXD,MF,3.32K,1%,0.25W	SMA-4-3.32K	CORNING
R170	110-8.06K-1	1	RESISTOR,FXD,MF,8.06K,1%,0.25W	SMA-4-8.06K	CORNING

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. K) Parts List (Page 7 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R171	110-4.02K-1		RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R172	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R173	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R174	110-5.11K-1	2	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R175	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R176	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R177	110-31.6K-1	1	RESISTOR,FXD,MF,31.6K,1%,0.25W	SMA-4-31.6K	CORNING
R178	110-14.7K-1		RESISTOR,FXD,MF,14.7K,1%,0.25W	SMA-4-14.7K	CORNING
R179	110-274-1	1	RESISTOR,FXD,MF,274,1%,0.25W	SMA-4-274	CORNING
R180	110-9.09K-1	2	RESISTOR,FXD,MF,9.09K,1%,0.25W	SMA-4-9.09K	CORNING
R181	110-750-1		RESISTOR,FXD,MF,750,1%,0.25W	SMA-4-750	CORNING
R182	110-750-1		RESISTOR,FXD,MF,750,1%,0.25W	SMA-4-750	CORNING
R183	110-9.09K-1		RESISTOR,FXD,MF,9.09K,1%,0.25W	SMA-4-9.09K	CORNING
R184	110-536-1	1	RESISTOR,FXD,MF,536,1%,0.25W	SMA-4-536	CORNING
R185	110-1.69K-1		RESISTOR,FXD,MF,1.69K,1%,0.25W	SMA-4-1.69K	CORNING
R186	110-7.50-1	1	RESISTOR,FXD,MF,7.50,1%,0.25W	SMA-4-7.50	CORNING
R187	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R188	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R189	110-18.7K-1	1	RESISTOR,FXD,MF,18.7K,1%,0.25W	SMA-4-18.7K	CORNING
R190	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R191	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R192	110-3.16K-1		RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4-3.16K	CORNING
R193	110-7.87K-1		RESISTOR,FXD,MF,7.87K,1%,0.25W	SMA-4-7.87K	CORNING
R194	110-12.1K-1	1	RESISTOR,FXD,MF,12.1K,1%,0.25W	SMA-4-12.1K	CORNING
R195	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-11K	CORNING
R196	110-13.3K-1	1	RESISTOR,FXD,MF,13.3K,1%,0.25W	SMA-4-13.3K	CORNING
R197	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R198	110-953-1		RESISTOR,FXD,MF,953,1%,0.25W	SMA-4-953	CORNING
R199	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R200	109-910-5	1	RESISTOR,FXD,MF,910,5%,0.125W	SMA-4-910	CORNING
R201	109-1.8K-5	1	RESISTOR,FXD,MF,1.8K,5%,0.12W	C3 1.8K 5%	CORNING
R202	109-750-5	1	RESISTOR,FXD,MF,750,5%,0.12W	C3 750OHM 5%	CORNING
R203	110-61.9-1	1	RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4-61.9	CORNING
TP1-TP13	551-608	1	CONNECTOR SOCKET,1 ROW, 0.150"	66947-013	BERG
TP14	702-17	1	TERMINAL,EYELET	20-2137D	VEROSPEED
U1	54-530	1	IC,CMOS,74HCT244,OCTAL	SN74HC244N	TEXAS INSTRUMENTS
U2	54-528	1	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U3	54-523	3	IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U4	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U5	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U6	54-132	4	IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U7	50-DG200BA	4	IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U8	54-132		IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U9	54-505	2	IC,D/A,7528,8BIT,BIN.,400nSEC	AD7528JN	ANALOG DEVICES
U10			NOT ASSIGNED		
U11	54-132		IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U12	54-537	1	IC,ALS TTL,74ALS38,QUADRUPLE	SN74ALS38N	TEXAS INSTRUMENTS
U13	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U14	54-132		IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U15	54-336	1	IC,CMOS,509,*,4 CHANNEL DIFF	DG509 ACJ	SILICONIX
U16	54-560	1	IC,ANALOG MULT,MPY634KP,10 MHZ	MPY634KP	BURR-BROWN
U17	54-501	1	IC,D/A,MP1232,12 BIT	MP1232HN	MICROPOWER
U18	54-53	1	IC,OP AMP,TL072,DUAL	TL072CP3	TEXAS INSTRUMENTS
U19	54-505		IC,D/A,7528,8BIT,BIN.,400nSEC	AD7528JN	ANALOG DEVICES
U20	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U21	54-503	11	IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U22	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U24	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U25	50-27	3	IC,OP AMP,OP37,SINGLE,6M,50V	OP-37EP	PRECISION MONOLITHIC
U26	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY

Table 5-17. A15 ALC PCB (6700-D-31715-3; Rev. K) Parts List (Page 8 of 8)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
U27	50-27		IC,OP AMP,OP37,SINGLE,6M,50V	OP-37EP	PRECISION MONOLITHIC
U28	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U29	50-34	1	IC,OP AMP,LT1056ACH,SINGLE	LT1056ACH	LINEAR TECHNOLOGY
U30			NOT ASSIGNED		
U31	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U32	54-24	2	IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U33	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U34	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U35	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U36	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U37	54-129	1	IC,D/A,AD7524,8 BITS	AD7524JN	ANALOG DEVICES
U38	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U39	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U40	50-33		IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U41	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U42	54-30	3	IC,COMPARATOR,LM311,SINGLE	LM311N	RCA
U43	54-30		IC,COMPARATOR,LM311,SINGLE	LM311N	RCA
U44	54-30		IC,COMPARATOR,LM311,SINGLE	LM311N	RCA
U45	20-46	1	TRANSISTOR,NPN,5 HIGH CURRENT	CA3183E	RCA
U46	50-9	1	IC,OP AMP,LF356,SINGLE	LF356N	NSC
VR1	54-502	1	IC,VOLTAGE REG,LT1031,10V	LT1031CCH	LINEAR TECHNOLOGY
W1	551-577	2	CONNECTOR SOCKET, GOLD	65474-001	BERG
W2	551-577		CONNECTOR SOCKET, GOLD	65474-001	BERG

Table 5-18. A16 FM PCB (6700-D-31716-3; Rev. G) Parts List (Page 1 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	250-42	22	CAPACITOR,FXD,TANT,10UF,10%,25V	96D106X9025KE3	SPRAGUE
C2	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C3	220-51	1	CAPACITOR,FXD,MICA,51PF,5%,500V	CD15ED510J03	CORNELL DUBILIER
C4	230-39	4	CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C5	230-49	1	CAPACITOR,FXD,0.022UF,100V	200-100-X7R-223K	CENTRE
C6	230-41	1	CAPACITOR,FXD,CER,1.0UF,20%,10V	400-100-601-105M	CENTRE
C7	230-37	3	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C9	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C10	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C11	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C12	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C13	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C14	250-102	2	CAPACITOR,FXD,PCAR,0.01UF,1%,5V	RV2A103F	IMB
C15	250-102		CAPACITOR,FXD,PCAR,0.01UF,1%,5V	RV2A103F	IMB
C16	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C17	227-12	1	CAPACITOR,FXD,PEST,0.1055UF,2%	ZV2B10052G	IMB
C18	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C19	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C20	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C21	220-820	1	CAPACITOR,FXD,MICA,820PF,5%,30V	CD15FC821J03	CORNELL DUBILIER
C22	223-10	2	CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C23	223-10		CAPACITOR,FXD,MICA,10PF,5%,500V	CD10CD100JO3M	CORNELL DUBILIER
C24	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C25	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C26	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C27	230-39		CAPACITOR,FXD,CER,0.1UF,10%,50V	8121-050-X7RO-104K	ERIE
C28	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C29	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C30			NOT ASSIGNED		
C31			NOT ASSIGNED		
C32	220-150	1	CAPACITOR,FXD,MICA,150PF,5%,50V	DM15F151J	ARCO/SOSHIN
C33	250-77	1	CAPACITOR,FXD,CER,0.01UF,10%,1V	CK05BX103K	SPRAGUE
C34	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C35	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C36	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C37	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C38	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C39	250-39	1	CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JE3	SPRAGUE
C40	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C41	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C42	220-24	1	CAPACITOR,FXD,MICA,24PF,5%,500V	CD15ED240JO3	CORNELL DUBILIER
C43	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C44	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C45-C57			NOT ASSIGNED		
C58	223-600	1	CAPACITOR,FXD,CER,1500PF,10%	200-100-X7R-152K	CENTRE ENG
CR1	10-FD300	13	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR2	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR3	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR4	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR5	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR6	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR7	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR8	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR9	10-11	3	DIODE,ZENER,1N750A,4.7V,5%	IN750A	FSC
CR10	10-11		DIODE,ZENER,1N750A,4.7V,5%	IN750A	FSC
CR11			NOT ASSIGNED		
CR12	10-4	1	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR13	10-1N4446	20	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR14	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL

Table 5-16. A16 FM PCB (6700-D-31716-3; Rev. G) Parts List (Page 2 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
CR15	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR16	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR17	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR18	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR19	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR20	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR21	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR22	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR23	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR24	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR25	10-1N754A	1	DIODE,ZENER,1N754A,6.8V,5%	1N754A	FSC
CR26	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR27	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR28	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR29	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR30	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR31	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR32	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR33	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR34	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR35	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR36	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR37	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR38	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR39	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR40	10-11		DIODE,ZENER,1N750A,4.7V,5%	IN750A	FSC
R1	110-604-1	2	RESISTOR,FXD,MF,604,1%,0.25	SMA-4-604	CORNING
R2	110-1K-1	11	RESISTOR,FXD,MF,1K,1%,0.25	SMA-4-1K	CORNING
R3	110-1.96K-1	7	RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R4	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R5	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R6	110-604-1		RESISTOR,FXD,MF,604,1%,0.25W	SMA-4-604	CORNING
R7	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R8	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R9	110-10K-1	21	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R10	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R11	110-5.36K-1	1	RESISTOR,FXD,MF,5.36K,1%,0.25W	SMA-4-5.36K	CORNING
R12	110-100-1	3	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R13	110-51.1-1	18	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R14	110-11K-1	2	RESISTOR,FXD,MF,11K,1%,0.25W	SMA-4-11K	CORNING
R15	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R16	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R17	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R18	110-3.16K-1	2	RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4-3.16K	CORNING
R19	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R20	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R21	110-3.16K-1		RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4-3.16K	CORNING
R22	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R23	110-1.87K-1	2	RESISTOR,FXD,MF,1.87K,1%,0.25W	SMA-4-1.87K	CORNING
R24	110-12.1K-1	1	RESISTOR,FXD,MF,12.1K,1%,0.25W	SMA-4-12.1K	CORNING
R25	110-1K-1		RESISTRO,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R26	110-13K-1	1	RESISTOR,FXD,MF,13K,1%,0.25W	SMA-4-13K	CORNING
R27	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R28	110-80.6K-1	1	RESISTOR,FXD,MF,80.6K,1%,0.25W	SMA-4-80.6K	CORNING
R29	110-7.5K-1	1	RESISTOR,FXD,MF,7.5K,1%,0.25W	SMA-4-7.5K	CORNING
R30	110-316-1	1	RESISTOR,FXD,MF,316,1%,0.25W	SMA-4-316	CORNING
R31	110-2.21K-1	1	RESISTOR,FXD,MF,2.21K,1%,0.25W	SMA-4-2.21K	CORNING
R32	110-100K-1	2	RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R33	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R34	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING

Table 5-18. A16 FM PCB (6700-D-31716-3; Rev. G) Parts List (Page 3 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R35	110-5.9K-1	2	RESISTOR,FXD,MF,5.9K,1%,0.25W	SMA-4-5.9K	CORNING
R36			NOT ASSIGNED		
R37	110-2.26K-1	1	RESISTOR,FXD,MF,2.26K,1%,0.25W	SMA-4-2.26K	CORNING
R38	110-95.3K-1	1	RESISTOR,FXD,MF,95.3K,1%,0.25W	SMA-4-95.3K	CORNING
R39	110-3.83K-1	3	RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4-3.83K	CORNING
R40	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R41	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R42	110-28.7K-1	2	RESISTOR,FXD,MF,28.7K,1%,0.25W	SMA-4-28.7K	CORNING
R43	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R44	110-5.9K-1		RESISTOR,FXD,MF,5.9K,1%,0.25W	SMA-4-5.9K	CORNING
R45	110-28.7K-1		RESISTOR,FXD,MF,28.7K,1%,0.25W	SMA-4-28.7K	CORNING
R46	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R47	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R48	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R49	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R50	110-8.06K-1	1	RESISTOR,FXD,MF,8.06K,1%,0.25W	SMA-4-8.06K	CORNING
R51	110-1.87K-1		RESISTOR,FXD,MF,1.87K,1%,0.25W	SMA-4-1.87K	CORNING
R52	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R53	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R54	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R55	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R56	110-18.2K-1	2	RESISTOR,FXD,MF,18.2K,1%,0.25W	SMA-4-18.2K	CORNING
R57	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R58	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R59	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R60	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R61	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R62	110-31.6-1	2	RESISTOR,FXD,MF,31.6,1%,0.25W	SMA-4-31.6	CORNING
R63	110-31.6-1		RESISTOR,FXD,MF,31.6,1%,0.25W	SMA-4-31.6	CORNING
R64	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R65	110-12.4K-1	1	RESISTOR,FXD,MF,12.4K,1%,0.25W	SMA-4-12.4K	CORNING
R66	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R67	110-3.83K-1		RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4-3.83K	CORNING
R68	110-30.1K-1	1	RESISTOR,FXD,MF,30.1K,1%,0.25W	SMA-4-30.1K	CORNING
R69	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R70	110-8.45K-1	1	RESISTOR,FXD,MF,8.45K,1%,0.25W	SMA-4-8.45K	CORNING
R71	110-3.83K-1		RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4-3.83K	CORNING
R72	110-4.02K-1	1	RESISTOR,FXD,MF,4.02K,1%,0.25W	SMA-4-4.02K	CORNING
R73	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R74	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R75	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING

Table 5-16. A16 FM PCB (6700-D-31716-3; Rev. G) Parts List (Page 4 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R76	110-44.2K-1	1	RESISTOR,FXD,MF,44.2K,1%,0.25W	SMA-4-44.2K	CORNING
R77	110-12.7K-1	1	RESISTOR,FXD,MF,12.7K,1%,0.25W	SMA-4-12.7K	CORNING
R78	110-40.2K-1	1	RESISTOR,FXD,MF,40.2K,1%,0.25W	SMA-4-40.2K	CORNING
R79	110-21.5K-1	1	RESISTOR,FXD,MF,21.5K,1%,0.25W	SMA-4-21.5K	CORNING
R80	110-2.15K-1		RESITOR,FXD,MF,2.15K,1%,0.25W	SMA-4-2.15K	CORNING
R81	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R82	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R83	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R84	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R85	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R86	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R87	110-196K-1	4	RESISTOR,FXD,MF,196K,1%,0.25W	SMA-4-196K	CORNING
R88	110-196K-1		RESISTOR,FXD,MF,196K,1%,0.25W	SMA-4-196K	CORNING
R89	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R90	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R91	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R92	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R93	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R94	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R95	110-196K-1		RESISTOR,FXD,MF,196K,1%,0.25W	SMA-4-196K	CORNING
R96	110-196K-1		RESISTOR,FXD,MF,196K,1%,0.25W	SMA-4-196K	CORNING
R97	110-4.64K-1	1	RESISTOR,FXD,MF,4.64K,1%,0.25W	SMA-4-4.64K	CORNING
R98	110-178K-1	1	RESISTOR,FXD,MF,178K,1%,0.25W	SMA-4-178K	CORNING
R99	110-14.7K-1	1	RESISTOR,FXD,MF,14.7K,1%,0.25W	SMA-4-14.7K	CORNING
R100	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R101	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R102	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R103	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R104	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R105	110-11K-1		RESISTOR,FXD,MF,11K,1%,0.25W	SMA-4-11K	CORNING
R106	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R107	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R108	113-665-0.5	3	RESISTOR,FXD,MF,665,0.5%,0.125W	RN55C,665,.5%	VERMONT PRECISION
R109	113-665-0.5		RESISTOR,FXD,MF,665,0.5%,0.125W	RN55C,665,.5%	VERMONT PRECISION
R110	110-825-1	1	RESISTOR,FXD,MF,825,1%,0.25W	SMA-4-825	CORNING
R111	113-332-0.5	1	RESISTOR,FXD,MF,332,0.5%,0.125W	RN55C,1.33K,.5%	VERMONT PRECISION
R112	110-4.22K-1	1	RESISTOR,FXD,MF,4.22K,1%,0.25W	SMA-4-4.22K	CORNING
R113	113-1.33K-0.5	3	RESISTOR,FXD,MF,1.33K,0.5%	RN55C,1.33K,.5%	VERMONT PRECISION
R114	113-1.33K-0.5		RESISTOR,FXD,MF,1.33K,0.5%	RN55C,1.33K,.5%	VERMONT PRECISION
R115	110-511-1	3	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R116	113-665-0.5		RESISTOR,FXD,MF,665,0.5%,0.125W	RN55C,665,.5%	VERMONT PRECISION
R117	110-9.53K-1	1	RESISTOR,FXD,MF,9.53K,1%,0.25W	SMA-4-9.53	CORNING
R118	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R119	110-41.2K-1	1	RESISTOR,FXD,MF,41.2K,1%,0.25W	SMA-4-41.2K	CORNING
R120	113-2.64K-0.5	2	RESISTOR,FXD,MF,2.64K,0.5%	RN55C,2.64K,.5%	VERMONT PRECISION
R121	113-2.64K-0.5		RESISTOR,FXD,MF,2.64K,0.5%	RN55C,2.64K,.5%	VERMONT PRECISION
R122	110-511-1		RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R123	113-1.33K-0.5		RESISTOR,FXD,MF,1.33K,0.5%	RN55C,1.33K,.5%	VERMONT PRECISION
R124	110-19.6K-1	1	RESISTOR,FXD,MF,19.6K,1%,0.25W	SMA-4-19.6K	CORNING
TP1-TP4	551-539	3	CONNECTOR,SOCKET,1 ROW-0.150"	66947-004	BERG
TP5-TP8	551-539		CONNECTOR,SOCKET,1 ROW-0.150"	66947-004	BERG
TP9-TP12	551-539		CONNECTOR,SOCKET,1 ROW-0.150"	66947-004	BERG
U1	50-30	5	IC,OP AMP,5532A,DUAL,300K OHM	NE5532N	SIGNETICS
U2	50-22	1	IC,OP AMP,NE5534,SINGLE	NE5534FE	SIGNETICS
U3	50-DG200BA	4	IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U4	50-9	8	IC,OP AMP,LF356,SINGLE	LF356N	NSC
U5	54-528	1	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U6	54-523	3	IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U7			NOT ASSIGNED		
U8	54-510	1	IC,CMOS,74HC04,HEX	SN74HC04N	TEXAS INSTRUMENTS

Table 5-18. A16 FM PCB (6700-D-31716-3; Rev. G) Parts List (Page 5 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
U9	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U10	54-334	1	IC,D/A,12 BIT	DAC 1208 LCD	NATIONAL
U11	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U12	54-24	2	IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U13	50-30		IC,OP AMP,5532A,DUAL,300K OHM	NE5532N	SIGNETICS
U14	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U15	50-7	2	IC,OP AMP,LF357,SINGLE	LF357N	NSC
U16	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U17	50-7		IC,OP AMP,LF357,SINGLE	LF357N	NSC
U18	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U19	54-53	2	IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U20	54-505	1	IC,D/A,7528,8BIT,BIN.,400nSEC	AD7528JN	ANALOG DEVICES
U21	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U22	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U23	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U24	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U25	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U26	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U27	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U28	54-132	2	IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U29	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U30	54-132		IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
W1	800-176	4	WIRE,JUMPER,0.500X0.175	.500 X .175 TEFLON	SQUIRES
W2	800-176		WIRE,JUMPER,0.500X0.175	.500 X .175 TEFLON	SQUIRES
W3	800-176		WIRE,JUMPER,0.500X0.175	.500 X .175 TEFLON	SQUIRES
W4	800-176		WIRE,JUMPER,0.500X0.175	.500 X .175 TEFLON	SQUIRES
W5	800-140	2	WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
W6	800-140		WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES

Table 5-19. A17 Analog Instruction PCB (6700-D-31717-3; Rev. H) Parts List (Page 1 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-37	13	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C2	250-42	36	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C3	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C4	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C6	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C8	227-51	1	CAPACITOR,FXD,PEST,0.0022UF,10V	ZA2B222K	IMB
C9	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C10	250-19	1	CAPACITOR,FXD,TANT,1UF,10%,35V	196D105X9035HE3	SPRAGUE
C11	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C12	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C13	220-200	4	CAPACITOR,FXD,MICA,200PF,5%,50V	CD15FD201J03	CORNELL DUBILIER
C14	250-123	1	CAPACITOR,FXD,PPRO,1.0uF,10%	X363uw 1.0/10/100	TRW
C15	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C16	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C17	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C18	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C19	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C20	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C21	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C22	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C23	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C24	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C25	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C26	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C27	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C28	220-200		CAPACITOR,FXD,MICA,200PF,5%,50V	CD15FD021J03	CORNELL DUBILIER
C29	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C30	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C31	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C32	220-200		CAPACITOR,FXD,MICA,200PF,5%,50V	CD15FD201J03	CORNELL DUBILIER
C33	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C34	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C35	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C36	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C37	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C38	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C39	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C40	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C41	227-50	4	CAPACITOR,FXD,PEST,0.01UF,2%,2V	ZA2C103G	IMB
C42	227-50		CAPACITOR,FXD,PEST,0.01UF,2%,2V	ZA2C103G	IMB
C43	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C44	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C45	227-50		CAPACITOR,FXD,PEST,0.01UF,2%,2V	ZA2C103G	IMB
C46	227-50		CAPACITOR,FXD,PEST,0.01UF,2%,2V	ZA2C103G	IMB
C47	230-41	2	CAPACITOR,FXD,CER,1.0UF,20%,10V	400-100-601-105M	CENTRE
C48	220-200		CAPACITOR,FXD,MICA,200PF,5%,50V	CD15FD201J03	CORNELL DUBILIER
C49	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C50	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C51	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C52	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C53			NOT ASSIGNED		
C54	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C55	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C56	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C57	230-41		CAPACITOR,FXD,CER,1.0UF,20%,10V	400-100-601-105M	CENTRE
C58	250-39	2	CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JE3	SPRAGUE
C59	250-39		CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JE3	SPRAGUE
C60	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE

Table 5-19. A17 Analog Instruction PCB (6700-D-31717-3; Rev. H) Parts List (Page 2 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C61	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C62	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C63	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C64	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
CR1	10-FD300	11	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR2	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR3	10-4	2	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR4	10-1N4446	2	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR5	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR6	10-1N751A	2	DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR7	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR8			NOT ASSIGNED		
CR9			NOT ASSIGNED		
CR10	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR11	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR12	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR13	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR14	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR15	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR16	10-1N757A		DIODE,ZENER,1N757A,9.1V,5%	1N757A	MOTOROLA
CR17	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR18	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR19	10-1N757A	2	DIODE,ZENER,1N757A,9.1V,5%	1N757A	MOTOROLA
L1	310-45	1	INDUCTOR,FXD,100.0UH,5%	1315-12J	AIRCO
L2	310-43	1	INDUCTOR,FXD,10.0UH,10%	1537-36	DELEVAN
Q1	20-2N3694	1	TRANSISTOR,NPN,2N3694,SI,GEN P	MPS3694-18	MOTOROLA
R1	113-10K-0.1	15	RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R2	110-100-1	20	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R3	110-49.9-1	2	RESISTOR,FXD,MF,49.9,1%,0.25W	SMA-4	CORNING
R4	110-49.9-1		RESISTOR,FXD,MF,49.9,1%,0.25W	SMA-4	CORNING
R5	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R6	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R7	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R8	110-51.1-1	9	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R9	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R10	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R11	110-90.9K-1	1	RESISTOR,FXD,MF,90.9K,1%,0.25W	SMA-4	CORNING
R12	113-10.18K-0.1	1	RESISTOR,FXD,MF,10.18K,0.1%	RN55C,10.18K,.1%	VERMONT PRECISION
R13	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R14	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R15	110-80.6K-1	1	RESISTOR,FXD,MF,80.6K,1%,0.25W	SMA-4	CORNING
R16	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R17	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R18	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R19	110-10K-1	9	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R20	110-17.8K-1	1	RESISTOR,FXD,MF,17.8K,1%,0.25W	SMA-4	CORNING
R21	110-825K-1	1	RESISTOR,FXD,MF,825K,1%,0.25W	SMA-4	CORNING
R22	110-1K-1	3	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R23	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C3	CORNING
R24	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4 OR C4	CORNING
R25	113-10K-0.1A	4	RESISTOR,FXD,MF,10K,0.1%	RN55E,10K,.1%	VERMONT PRECISION
R26	113-10K-0.1A		RESISTOR,FXD,MF,10K,0.1%	RN55E,10K,.1%	VERMONT PRECISION
R28	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R29	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125W	RN55C,10K,.1%	VERMONT PRECISION
R30	110-2K-1	2	RESISTOR,FXD,MF,2K,1%,0.25W	SMA-4	CORNING
R31	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R32	110-24.9-1	1	RESISTOR,MF,1/4W,1%	SMA-4	CORNING
R33	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING
R34	110-2K-1		RESISTOR,FXD,MF,2K,1%,0.25W	SMA-4	CORNING
R35	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4 OR C4	CORNING

Table 5-19. A17 Analog Instruction PCB (6700-D-31717-3; Rev. H) Parts List (Page 5 of 5)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
U12	54-526		IC,74HCT04,HEX INVERTERS	CE74HCT04E	RCA
U13	54-458		IC,ANALOG SWITCH,DG 508,8	DG508CJ	SILICONIX
U14	54-528	2	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U15	50-DG200BA	3	IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U16	54-520		IC,CMOS,74HC273,OCTAL D-TYPE	SN74HC273N	TEXAS INSTRUMENTS
U17	54-528		IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U18	54-334	2	IC,D/A,12 BIT	DAC 1208 LCD	NATIONAL
U19	54-53	8	IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U20	54-24	5	IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U21	54-503	7	IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U22	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U23	54-524		IC,CMOS,74HCT00,QUAD 2-INPUT	MC74HCT00N	MOTOROLA
U24	54-334		IC,D/A,12 BIT	DAC 1208 LCD	NATIONAL
U25	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U26	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U27	54-30	1	IC,COMPARATOR,LM311,SINGLE	LM311N	RCA
U28	54-502	2	IC,VOLTAGE REG,LT1031,10V	LT1031CCH	LINEAR TECHNOLOGY
U30	54-502		IC,VOLTAGE REG,LT1031,10V	LT1031CCH	LINEAR TECHNOLOGY
U31	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U32	54-132	1	IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U33	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U34	54-460	2	IC,D/A,9331,16 BIT,+11,5V	MP9331-16-4	MICRO POWER
U35	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U36	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U37	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U38	54-460		IC,D/A,9331,16 BIT,+11,5V	MP9331-16-4	MICRO POWER
U39	54-503		IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U40	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTSTRUMENTS
U41	50-DG200BA		IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U42	54-505	1	IC,D/A,7528,8BIT,BIN.,400nSEC	AD7528JN	ANALOG DEV
U45	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U46	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U47	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U48	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U49	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U50	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U51	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U52	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS

Table 5-20. A18 YIG Driver PCB (2-8 GHz; 6700-D-31718-4; Rev. B) Parts List

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
			NOTE: THE A18 (2-8 GHz) YIG DRIVER PCB (P/N 6700-D-31718-4) INCLUDES ALL COMMON PARTS LISTED IN TABLE 5-26 PLUS THOSE LISTED BELOW:		
C2*	230-3	1	CAPACITOR,FXD,CER,1000PF,10%	DD-102	CENTRALAB
C3*	223-10	1	CAPACITOR,FXD,MICA,10PF,5%	CD10CD100JO3M	CORNELL DUBILIER
C17*	220-200	1	CAPACITOR,FXD,MICA,200PF,5%		
C24*	230-53	1	CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C27*	230-48	1	CAPACITOR,FXD,.018uF,+/-10%	200-100-X7R-183K	CENTRE ENG
C36	250-77	6	CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
C37	220-10	1	CAPACITOR,FXD,MICA,10PF,5%		
C38	250-19	1	CAPACITOR,FXD,TANT,1UF,10%,35V	196D105X9035HE3	SPRAGUE
C41			NOT ASSIGNED		
CR28	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR30	10-STB568		DIODE,RECTIFIER,STB568,GOV,?	STB568	GENERAL ELECTRIC
CR31	10-1N755A	1	DIODE,ZENER,1N755A,7.5V,5%	1N755A	MOTOROLA
CR33	10-STB568		DIODE,RECTIFIER,STB568,GOV	STB568	GENERAL ELECTRIC
R6*	110-12.7K-1	1	RESISTOR,FXD,MF,12.7K,1%,0.25		
R8*	110-1.87K-1	1	RESISTOR,FXD,MF,1.87K,1%,0.25		
R9*	110-12.4K-1	1	RESISTOR,FXD,MF,12.4K,1%,0.25		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10K		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R45*	113-105K-1	1	RESISTOR,FXD,MF,105K,1%,		
R46*	110-464K-1	1	RESISTOR,FXD,MF,464K,1%,0.25		
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R56*	113-27.4K-1	1	RESISTOR,FIXED,METEL FILM,27.4K		
R73	110-15K-1	1	RESISTOR,FXD,MF,15K,1%,0.25		
R74	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R75	103-6.8-5	1	RESISTOR,FXD,CC,6.8,5%,1W	RC32GF6.8J	ALLEN BRADLEY
R76	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R80*	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R82	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R83	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25		
R84	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125		
R85*	113-4.99K-0.1	1	RESISTOR,FXD,MF,4.99K,0.1%,0.1		
R86	130-1-3		RESISTOR,FXD,WW,1,5%,3.25W	UT-2C-20	ULTEX
R89	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R91*			NOT ASSIGNED		
U9	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U10	50-6	2	IC OP AMP,LM358,DUAL	MLM358	MOTOROLA

Table 5-21. A18 YIG Driver PCB (2-8 GHz; 6700-D-31718-9; Rev. B) Parts List

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
			NOTE: THE A18 (2-8 GHz) YIG DRIVER PCB (P/N 6700-D-31718-9) INCLUDES ALL COMMON PARTS LISTED IN TABLE 5-26 PLUS THOSE LISTED BELOW:		
C2*	230-3	1	CAPACITOR,FXD,CER,1000PF,10%	DD-102	CENTRALAB
C3*	223-10	1	CAPACITOR,FXD,MICA,10PF,5%	CD10CD100JO3M	CORNELL DUBILIER
C17*	220-200	1	CAPACITOR,FXD,MICA,200PF,5%		
C24*	230-53	1	CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C27*	230-48	1	CAPACITOR,FXD,.018uF,+/-10%	200-100-X7R-183K	CENTRE ENG
C36	250-77	6	CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
C37	220-10	1	CAPACITOR,FXD,MICA,10PF,5%		
C38	250-19	1	CAPACITOR,FXD,TANT,1UF,10%,35V	196D105X9035HE3	SPRAGUE
C41	250-77		CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
CR28	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR30	10-STB568		DIODE,RECTIFIER,STB568,GOV	STB568	GENERAL ELECTRIC
CR31	10-1N755A	1	DIODE,ZENER,1N755A,7.5V,5%	1N755A	MOTOROLA
CR33	10-STB568		DIODE,RECTIFIER,STB568	STB568	GENERAL ELECTRIC
R6*	110-12.7K-1	1	RESISTOR,FXD,MF, 12.7K,1%,0.25		
R8*	110-1.87K-1	1	RESISTOR,FXD,MF, 1.87K,1%,0.25		
R9*	110-12.4K-1	1	RESISTOR,FXD,MF, 12.4K,1%,0.25		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10K		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R45*	113-105K-1	1	RESISTOR,FXD,MF,105K,1%,		
R46*	110-464K-1	1	RESISTOR,FXD,MF,464K,1%,0.25		
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R56*	113-27.4K-1	1	RESISTOR,FIKED,METEL FILM,27.4K		
R73	110-15K-1	1	RESISTOR,FXD,MF,15K,1%,0.25		
R74	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R75	103-6.8-5	1	RESISTOR,FXD,CC,6.8,5%,1W	RC32GF6.8J	ALLEN BRADLEY
R76	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R80*	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R82	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R83	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25		
R84	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125		
R85*	113-4.99K-0.1	1	RESISTOR,FXD,MF,4.99K,0.1%,0.1		
R86	130-1-3		RESISTOR,FXD,WW,1,5%,3.25W	UT-2C-20	ULTEX
R89	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R91*	110-105K-1	1	RESISTOR,FXD,MF,105K,1%,0.25W		
U9	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U10	50-6	2	IC,OP AMP,LM358,DUAL	MLM358	MOTOROLA

Table 5-22. A19 YIG Driver PCB (8-12.4 GHz; 6700-D-31718-5; Rev. B) Parts List

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
			NOTE: THE A19 (8-12.4 GHz) YIG DRIVER PCB (P/N 6700-D-31718-5) INCLUDES ALL COMMON PARTS LISTED IN TABLE 5-26 PLUS THOSE LISTED BELOW:		
C2*	220-680	1	CAPACITOR,FXD,MICA,680PF,5%	DM15-681J	ADI,ARCO/SOSHIN
C3*	223-10	1	CAPACITOR,FXD,MICA,10PF,5%	CD10CD100JO3M	CORNELL DUBILIER
C17*	220-390	1	CAPACITOR,FXD,MICA,390PF,5%	DM15-391T	ELMENCO
C24*	230-53	1	CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C27*	230-47	1	CAPACITOR,FXD,.01uF,+/-10%	200-100-X7R-103K	CENTRE ENG
C36			NOT ASSIGNED		
C37			NOT ASSIGNED		
C38			NOT ASSIGNED		
C41			NOT ASSIGNED		
CR28			NOT ASSIGNED		
CR30			NOT ASSIGNED		
CR31			NOT ASSIGNED		
CR33			NOT ASSIGNED		
R6*	110-12.1K-1	1	RESISTOR,FXD,MF,12.1K,1%,0.25		
R8*	110-2.74K-1	1	RESISTOR,FXD,MF,2.74K,1%,0.25		
R9*	110-12.4K-1	1	RESISTOR,FXD,MF,12.4K,1%,0.25		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10K		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R45*	113-26.1K-1	1	RESISTOR,FIXED,METAL FILM,26.1K		
R46*	110-499K-1	1	RESISTOR,FXD,MF,499K,1%,0.25		
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R56*	113-34.8K-1	1	RESISTOR,FIXED,METAL FILM,34.8K		
R73			NOT ASSIGNED		
R74			NOT ASSIGNED		
R75			NOT ASSIGNED		
R76			NOT ASSIGNED		
R80*	110-4.99K-1		RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R82			NOT ASSIGNED		
R83			NOT ASSIGNED		
R84			NOT ASSIGNED		
R85*			NOT ASSIGNED		
R86			NOT ASSIGNED		
R89			NOT ASSIGNED		
R91*			NOT ASSIGNED		
U9			NOT ASSIGNED		
U10			NOT ASSIGNED		

Table 5-23. A20 YIG Driver PCB (12.4-20 GHz; 6700-D-31718-6; Rev. B) Parts List

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
			NOTE: THE A20 (12.4-20 GHz) YIG DRIVER PCB (P/N 6700-D-31718-6) INCLUDES ALL COMMON PARTS LISTED IN TABLE 5-26 PLUS THOSE LISTED BELOW:		
C2*	230-3	1	CAPACITOR,FXD,CER,1000PF,10%	DD-102	CENTRALAB
C3*	223-15	1	CAPACITOR,FXD,MICA,15PF,5%,	CM04CD150JO3	ARCO/SOSHIN
C17*	220-270	1	CAPACITOR,FXD,MICA,270PF,5%	CD15FD271J03M	CORNELL DUBILIER
C24*	230-53	1	CAPACITOR,FXD,39pF,+/-5%	150-100-NPO-390J	CENTRE ENG
C27*	230-91	1	CAPACITOR,FXD,CER,4700pF	150-100-472K	CENTRE ENG
C36			NOT ASSIGNED		
C37			NOT ASSIGNED		
C38			NOT ASSIGNED		
C41	250-77		CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
CR28	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR30			NOT ASSIGNED		
CR31			NOT ASSIGNED		
CR33	10-STB568		DIODE,RECTIFIER,STB568,GOV	STB568	GENERAL ELECTRIC
R6*	110-12.7K-1	1	RESISTOR,FXD,MF,12.7K,1%,0.25		
R8*	110-1.87K-1	1	RESISTOR,FXD,MF,1.87K,1%,0.25		
R9*	110-8.25K-1	1	RESISTOR,FXD,MF,8.25K,1%,0.25		
R40			NOT ASSIGNED		
R41			NOT ASSIGNED		
R42			NOT ASSIGNED		
R43			NOT ASSIGNED		
R45*	113-14.3K-1	1	RESISTOR,FIXED,METAL FILM,14.3K		
R46*	110-422K-1	1	RESISTOR,FXD,MF,422K,1%,0.25		
R52			NOT ASSIGNED		
R53			NOT ASSIGNED		
R54			NOT ASSIGNED		
R55			NOT ASSIGNED		
R56*	113-17.8K-1	1	RESISTOR,FIXED,METAL FILM,17.8K		
R73			NOT ASSIGNED		
R74			NOT ASSIGNED		
R75			NOT ASSIGNED		
R76			NOT ASSIGNED		
R80*	110-2K-1	2	RESISTOR,FXD,MF,2K,1%,0.25		
R82	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R83	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25		
R84	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25		
R85*	110-2K-1		RESISTOR,FXD,MF,2K,1%,0.25		
R86	130-1-3		RESISTOR,FXD,WW,1,5%,3.25W	UT-2C-20	ULTEX
R89			NOT ASSIGNED		
R91*			NOT ASSIGNED		
U9			NOT ASSIGNED		
U10	50-6	2	IC OP AMP,LM358,DUAL	MLM358	MOTOROLA

Table 5-24. A21 YIG Driver PCB (20-26.5 GHz; 6700-D-31718-7; Rev. B) Parts List

NOTE: THE A21 (20-26.5 GHz) YIG DRIVER PCB (P/N 6700-D-31718-7) INCLUDES ALL COMMON PARTS LISTED IN TABLE 5-26 PLUS THOSE LISTED BELOW:

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C2*	230-3	1	CAPACITOR,FXD,CER,1000PF,10%	DD-102	CENTRALAB
C3*	223-15	1	CAPACITOR,FXD,MICA,15PF,5%	CM04CD150JO3	ARCO/SOSHIN
C17*	220-470	1	CAPACITOR,FXD,MICA,470PF,5%		
C24*	230-71	1	CAPACITOR,FIXED,CER,68pf,5%	150-100-NPO-680J	CENTRE ENG
C27*	230-91	1	CAPACITOR,FXD,CER,4700pF	150-100-472K	CENTRE ENG
C36			NOT ASSIGNED		
C37			NOT ASSIGNED		
C38			NOT ASSIGNED		
C41			NOT ASSIGNED		
CR28			NOT ASSIGNED		
CR30			NOT ASSIGNED		
CR31			NOT ASSIGNED		
CR33			NOT ASSIGNED		
R6*	110-12.7K-1	1	RESISTOR,FXD,MF,12.7K,1%,0.25		
R8*	110-1.87K-1	1	RESISTOR,FXD,MF,1.87K,1%,0.25		
R9*	110-10.2K-1	1	RESISTOR,FXD,MF,10.2K,1%,0.25		
R40	113-10K-1	8	RESISTOR,FIXED,METAL FILM,10K		
R41	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R42	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R43	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R45*	113-15K-1	1	RESISTOR,FIXED,METAL FILM15K		
R46*	110-499K-1	1	RESISTOR,FXD,MF,499K,1%,0.25		
R52	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R53	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R54	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R55	113-10K-1		RESISTOR,FIXED,METAL FILM,10K		
R56*	113-30.9K-1	1	RESISTOR,FIXED,METAL FILM,30.9K		
R73			NOT ASSIGNED		
R74			NOT ASSIGNED		
R75			NOT ASSIGNED		
R76			NOT ASSIGNED		
R80*	110-2K-1	1	RESISTOR,FXD,MF,2K,1%,0.25		
R82			NOT ASSIGNED		
R83			NOT ASSIGNED		
R84			NOT ASSIGNED		
R85*			NOT ASSIGNED		
R86			NOT ASSIGNED		
R89			NOT ASSIGNED		
R91*			NOT ASSIGNED		
U9			NOT ASSIGNED		
U10			NOT ASSIGNED		

Table 5-25. A21 YIG Driver PCB (18-26.5 GHz; 6700-D-31718-8; Rev. B) Parts List

NOTE: THE A21 (18-26.5 GHz) YIG DRIVER PCB (P/N 6700-D-31718-8) INCLUDES ALL COMMON PARTS LISTED IN TABLE 5-26 PLUS THOSE LISTED BELOW:

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C2*	230-3	1	CAPACITOR,FXD,CER,1000PF,10%	DD-102	CENTRALAB
C3*	223-15	1	CAPACITOR,FXD,MICA,15PF,5%	CM04CD150JO3	ARCO/SOSHIN
C17*	220-470	1	CAPACITOR,FXD,MICA,470PF,5%		
C24*	230-71	1	CAPACITOR,FIXED,CER,68pf,5%	150-100-NPO-680J	CENTRE ENG
C27*	230-91	1	CAPACITOR,FXD,CER,4700pF	150-100-472K	CENTRE ENG
C36					
C37					
C38					
C41					
CR28					
CR30					
CR31					
CR33					
R6*	110-12.7K-1	1	RESISTOR,FXD,MF,12.7K,1%,0.25		
R8*	110-1.87K-1	1	RESISTOR,FXD,MF,1.87K,1%,0.25		
R9*	110-10.2K-1	1	RESISTOR,FXD,MF,10.2K,1%,0.25		
R40			NOT ASSIGNED		
R41			NOT ASSIGNED		
R42			NOT ASSIGNED		
R43			NOT ASSIGNED		
R45*	113-16.2K-1	1	RESISTOR,FIXED,METAL FILM,16.2K		
R46*	110-499K-1	1	RESISTOR,FXD,MF,499K,1%,0.25		
R52			NOT ASSIGNED		
R53			NOT ASSIGNED		
R54			NOT ASSIGNED		
R55			NOT ASSIGNED		
R56*	113-33.2K-1	1	RESISTOR,FIXED,METAL FILM,33.2K		
R73					
R74					
R75					
R76					
R80*	110-2K-1	1	RESISTOR,FXD,MF,2K,1%,0.25		
R82					
R83					
R84					
R85*					
R86					
R89					
R91*					
U9					
U10					

Table 5-26. YIG Driver PCB Common Parts List (Page 1 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	227-45	2	CAPACITOR,FXD,MYLR,0.1UF,20%	230B1B104M	ELECTROCUBE
C2*			REFER TO TABLES 5-20 THRU 5-25		
C3*			REFER TO TABLES 5-20 THRU 5-25		
C4	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C5	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C6	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C7	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C8	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C9	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C10			NOT ASSIGNED		
C11			NOT ASSIGNED		
C12			NOT ASSIGNED		
C13			NOT ASSIGNED		
C14			NOT ASSIGNED		
C15	250-77		CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
C16	250-77		CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
C17*			REFER TO TABLES 5-20 THRU 5-25		
C18	250-41	1	CAPACITOR,FXD,TANT,6.8UF,10%	196D685X9035KE3	SPRAGUE
C19	230-37		CAPACITOR,FXD,CER,0.1UF,20%	RPE122104M100V	MURATA/ERIE
C20	250-42	9	CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C21	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C22	227-45		CAPACITOR,FXD,MYLR,0.1UF,20%	230B1B104M	ELECTROCUBE
C23	220-560	1	CAPACITOR,FXD,MICA,560PF,5%	DM15F561J300	ARCO
C24*			REFER TO TABLES 5-20 THRU 5-25		
C25	220-130	1	CAPACITOR,FXD,MICA,130PF,5%	CD15FD131JO3	CORNELL DUBILIER
C26	250-42		CAPACITOR,FXD,TANT,10UF,10%	196D106X9025KE3	SPRAGUE
C27*			REFER TO TABLES 5-20 THRU 5-25		
C28	230-37		CAPACITOR,FXD,CER,0.1UF,20%	RPE122104M100V	MURATA/ERIE
C29	250-51	2	CAPACITOR,FXD,ALUM,47UF,-10/+5%	T3073FE470T063JPT	MEPCO
C30	223-100	1	CAPACITOR,FXD,MICA,100PF,5%,50	CD10FD101J03	CORNELL DUBILIER
C31	250-51		CAPACITOR,FXD,ALUM,47UF,-10/+5%	T3073FE470T063JPT	MEPCO
C32			NOT ASSIGNED		
C33	230-37	6	CAPACITOR,FXD,CER,0.1UF,20%	RPE122104M100V	MURATA/ERIE
C34	250-77		CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
C35			NOT ASSIGNED		
C36			REFER TO TABLES 5-20 THRU 5-25		
C37			REFER TO TABLES 5-20 THRU 5-25		
C38			REFER TO TABLES 5-20 THRU 5-25		
C39	250-77		CAPACITOR,FXD,CER,0.01UF,10%	CK05BX103K	SPRAGUE
C40			NOT ASSIGNED		
C41			REFER TO TABLES 5-20 THRU 5-25	CK05BX103K	SPRAGUE
C42			NOT ASSIGNED		
C43	230-37		CAPACITOR,FXD,CER,0.1UF,20%	RPE122104M100V	MURATA/ERIE
C44	230-37		CAPACITOR,FXD,CER,0.1UF,20%	RPE122104M100V	MURATA/ERIE
C45	230-37		CAPACITOR,FXD,CER,0.1UF,20%	RPE122104M100V	MURATA/ERIE
CR1	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR2	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR3	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR4	10-1N746A	2	DIODE,ZENER,1N746,3.3V,10%	1N746	MOTOROLA
CR5	10-1N4446	8	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR6	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR7	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR8	10-1N746A		DIODE,ZENER,1N746,3.3V,10%	1N746	MOTOROLA
CR9			NOT ASSIGNED		
CR10			NOT ASSIGNED		
CR11	10-SI2	3	DIODE,RECTIFIER,IN4003,200V	SS6253	SEMTECH
CR12	10-1N5359A	1	DIODE,ZENER,1N5359,24V,20%	1N5359A	MOTOROLA
CR13	10-FD300	3	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE DEVICES
CR14	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR15	10-FD300		DIODE,RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE DEVICES

Table 5-26. YIG Driver PCB Common Parts List (Page 2 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
CR16	10-FD300		DIODE,RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE DEVICES
CR17	10-1N962B	1	DIODE,ZENER,1N962,11V,5%	1N962B	MOTOROLA
CR18	10-11	1	DIODE,ZENER,1N750A,4.7V,5%	IN750A	FSC
CR19	10-25	2	DIODE,RECTIFIER,MR854,400V,100	MR854	MOTOROLA
CR20	10-25		DIODE,RECTIFIER,MR854,400V,100	MR854	MOTOROLA
CR21	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR22	15-5	1	INDICATOR,LED,RED	MV5774C	MONSANTO
CR23			NOT ASSIGNED		
CR24			NOT ASSIGNED		
CR25			NOT ASSIGNED		
CR26	10-4	3	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR27	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR28			REFER TO TABLES 5-20 THRU 5-25		
CR29	10-STB568	4	DIODE,RECTIFIER,STB568,GOV	STB568	GENERAL ELECTRIC
CR30			REFER TO TABLES 5-20 THRU 5-25		
CR31		1	REFER TO TABLES 5-20 THRU 5-25		
CR32	10-STB568		DIODE,RECTIFIER,STB568,GOV	STB568	GENERAL ELECTRIC
CR33			REFER TO TABLES 5-20 THRU 5-25		
CR34	10-SI2		DIODE,RECTIFIER,IN4003,200V	SS6253	SEMTECH
CR35	10-SI2		DIODE,RECTIFIER,IN4003,200V	SS6253	SEMTECH
CR36	10-1N751A	1	DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
P1	551-517	1	CONNECTOR,SOCKET,1ROW-.1"X.1"	100-083-30218-190	TEKA PRODUCTS
Q1			NOT ASSIGNED		
Q2			NOT ASSIGNED		
Q3	20-45	1	TRANSISTOR,FET,N CHANNEL ENH	VN10KM	SILICONIX
Q4	20-MPSA92	1	TRANSISTOR,PNP,MPSA92,SI,HIGH	MPSA92	MOTOROLA
Q5			NOT ASSIGNED		
Q6	20-MPSA42	3	TRANSISTOR,NPN,MPSA42,SI,HIGH	MPSA42	MOTOROLA
Q7	20-MPSA42		TRANSISTOR,NPN,MPSA42,SI,HIGH	MPSA42	MOTOROLA
Q8			NOT ASSIGNED		
Q9	20-MPSA42		TRANSISTOR,NPN,MPSA42,SI,HIGH	MPSA42	MOTOROLA
R1	110-10K-1	7	RESISTOR,FXD,MF,10K,1%,0.25		
R2	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25		
R3	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25		
R4	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25		
R5	110-1.78K-1	1	RESISTOR,FXD,MF,1.78K,1%,0.25		
R6*			REFER TO TABLES 5-20 THRU 5-25		
R7	130-47-3	1	RESISTOR,FXD,WW,47,5%,3.25W		
R8*			REFER TO TABLES 5-20 THRU 5-25		
R9*			REFER TO TABLES 5-20 THRU 5-25		
R10	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R11	110-196-1	2	RESISTOR,FXD,MF,196,1%,0.25		
R12	130-15-3		RESISTOR,FXD,WW,15,5%,3.25W		
R13	110-4.42K-1	2	RESISTOR,FXD,MF,4.42K,1%,0.25		
R14	130-15-3		RESISTOR,FXD,WW,15,5%,3.25W		
R15	130-15-3	4	RESISTOR,FXD,WW,15,5%,3.25W		
R16	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R17	110-4.42K-1		RESISTOR,FXD,MF,4.42K,1%,0.25		
R18	110-196-1		RESISTOR,FXD,MF,196,1%,0.25		
R19	130-15-3		RESISTOR,FXD,WW,15,5%,3.25W		
R20			NOT ASSIGNED		
R21			NOT ASSIGNED		
R22	110-8.06K-1	2	RESISTOR,FXD,MF,8.06K,1%,0.25		
R23	110-16.2K-1	2	RESISTOR,FXD,MF,16.2K,1%,0.25		
R24	110-8.06K-1		RESISTOR,FXD,MF,8.06K,1%,0.25		
R25	110-16.2K-1		RESISTOR,FXD,MF,16.2K,1%,0.25		
R26	110-51.1K-1	1	RESISTOR,FXD,MF,51.1K,1%,0.25		
R27	110-30.1K-1	1	RESISTOR,FXD,MF,30.1K,1%,0.25		
R28	113-3.01K-0.1	1	RESISTOR,FXD,MF,3.01K,0.1%,0.1		
R29	131-35	1	RESISTOR,FXD,WW,3,3%,5W,3PPM		

Table 5-26. YIG Driver PCB Common Parts List (Page 3 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R30	110-30.1-1	1	RESISTOR,FXD,MF,30.1,1%,0.25	SMA-4 OR C4	CORNING
R31	110-511-1	4	RESISTOR,FXD,MF,511,1%,0.25		
R32	110-31.6K-1	1	RESISTOR,FXD,MF,31.6K,1%,0.25		
R33	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R34	110-100-1	11	RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R35	110-5.11K-1	2	RESISTOR,FXD,MF,5.11K,1%,0.25		
R36	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25		
R37	110-825-1	1	RESISTOR,FXD,MF,825,1%,0.25		
R38	110-8.66K-1	1	RESISTOR,FXD,MF,8.66K,1%,0.25		
R39	110-59K-1	1	RESISTOR,FXD,MF,59K,1%,0.25		
R40			REFER TO TABLES 5-20 THRU 5-25		
R41			REFER TO TABLES 5-20 THRU 5-25		
R42			REFER TO TABLES 5-20 THRU 5-25		
R43			REFER TO TABLES 5-20 THRU 5-25		
R44	110-1K-1	3	RESISTOR,FXD,MF,1K,1%,0.25		
R45*			REFER TO TABLES 5-20 THRU 5-25		
R46*			REFER TO TABLES 5-20 THRU 5-25		
R47	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25		
R48	110-511-1		RESISTOR,FXD,MF,511,1%,0.25		
R49	110-51.1-1	1	RESISTOR,FXD,MF,51.1,1%,0.25	SMA-4 OR C4	CORNING
R50	110-348-1	1	RESISTOR,FXD,MF,348,1%,0.25		
R51	102-.5-5	1	RESISTOR,FXD,CC,0.5,5%,0.5W	UT-1/2 5% 0.5ohm	
R52			REFER TO TABLES 5-20 THRU 5-25		
R53			REFER TO TABLES 5-20 THRU 5-25		
R54			REFER TO TABLES 5-20 THRU 5-25		
R55			REFER TO TABLES 5-20 THRU 5-25		
R56*			REFER TO TABLES 5-20 THRU 5-25		
R57	110-511-1		RESISTOR,FXD,MF,511,1%,0.25		
R58	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25		
R59	110-1.54K-1	1	RESISTOR,FXD,MF,1.54K,1%,0.25		
R60	110-38.3K-1	1	RESISTOR,FXD,MF,38.3K,1%,0.25		
R61	110-332-1	1	RESISTOR,FXD,MF,332,1%,0.25		
R62	113-10K-0.1	5	RESISTOR,FXD,MF,10K,0.1%,0.125		
R63	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125		
R64	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125		
R65	113-10K-0.1		RESISTOR,FXD,MF,10K,0.1%,0.125		
R66	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R67	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25		
R68	110-100K-1	3	RESISTOR,FXD,MF,100K,1%,0.25		
R69	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R70	130-1-3	3	RESISTOR,FXD,WW,1,5%,3.25W	UT-2C-20	ULTEX
R71	110-4.99K-1	4	RESISTOR,FXD,MF,4.99K,1%,0.25	SMA-4 OR C4	CORNING
R72	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25		
R73			REFER TO TABLES 5-20 THRU 5-25		
R74			REFER TO TABLES 5-20 THRU 5-25		
R75			REFER TO TABLES 5-20 THRU 5-25		
R76			REFER TO TABLES 5-20 THRU 5-25		
R77	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R78	110-100K-1		RESISTOR,FXD,MF,100K,1%,0.25		
R79	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25		
R80*			REFER TO TABLES 5-20 THRU 5-25		
R81	130-1-3		RESISTOR,FXD,WW,1,5%,3.25W	UT-2C-20	ULTEX
R82			REFER TO TABLES 5-20 THRU 5-25		
R83			REFER TO TABLES 5-20 THRU 5-25		
R84			REFER TO TABLES 5-20 THRU 5-25		
R85*			REFER TO TABLES 5-20 THRU 5-25		
R86			REFER TO TABLES 5-20 THRU 5-25		
R87	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R88	110-100-1		RESISTOR,FXD,MF,100,1%,0.25	SMA-4 OR C4	CORNING
R89			REFER TO TABLES 5-20 THRU 5-25		

Table 5-26. YIG Driver PCB Common Parts List (Page 4 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R90	110-511-1		RESISTOR,FXD,MF,511,1%,0.25		
R91*			REFER TO TABLES 5-20 THRU 5-25		
TP1-TP13	551-608	1	CONNECTOR SOCKET,1 ROW, 0.150"	66947-013	BERG
U1	50-9	3	IC,OP AMP,LF356,SINGLE	LF356N	NSC
U2	50-DG200BA	1	IC,ANALOG SWITCH,DG200,DUAL	DG200ABA	SILICONIX
U3	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U4	54-132	1	IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U5	54-24	1	IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U6	54-376	1	IC,OP-AMP,OP27EJ,SINGLE,25uV	OP27EJ	PRECISION MONOLITHIC
U7	54-336	1	IC,CMOS,509,4 CHANNEL DIFFER	DG509 ACJ	SILICONIX
U8	50-6		IC, OP AMP,LM358,DUAL	MLM358	MOTOROLA
U9	50-9		IC,OP AMP,LF356,SINGLE	LF356N	NSC
U10			REFER TO TABLES 5-20 THRU 5-25		
W1	800-260	3	WIRE,JUMPER,1.000X0.125,	J1.000X0.125T22	SQUIRES
W2	800-260		WIRE,JUMPER,1.000X0.125,	J1.000X0.125T22	SQUIRES
W3	800-260		WIRE,JUMPER,1.000X0.125,	J1.000X0.125T22	SQUIRES
W4		4	REFER TO TABLES 5-20 THROUGH 5-25		
W5	800-140	1	WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES

Table 5-27. A22 Regulator Interface PCB (6700-D-31722-3; Rev. F) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-41	2	CAPACITOR,FXD,CER,1.0UF,20%,10V	400-100-601-105M	CENTRE
C2	250-42	2	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C3	230-41		CAPACITOR,FXD,CER,1.0UF,20%,10V	400-100-601-105M	CENTRE
C4	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C5	250-39	1	CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JE3	SPRAGUE
C6	230-30	2	CAPACITOR,FXD,CER,1000PF,+80/-20	BGP.001,500V,+80-20	RMC
C7	227-45	1	CAPACITOR,FXD,MYLR,0.1UF,20%,1V	230B1B104M	ELECTROCUBE
C8	227-50	1	CAPACITOR,FXD,PEST,0.01UF,2%,2V	ZA2C103G	IMB
C9	230-30		CAPACITOR,FXD,CER,1000PF,+80/-20	BGP.001,500V,+80-20	RMC
C10	250-34	2	CAPACITOR,FXD,ALUM,10UF,-10/+5	3070-CD100T063SF	MEPCO
C11	250-34		CAPACITOR,FXD,ALUM,10UF,-10/+5	3070-CD100T063SF	MEPCO
C12	250-136	16	CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C13	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C14	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C15	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C16	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C17	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C18	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C19	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C20	230-37	2	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C22	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C23	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C24	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C25	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C26	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C27	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C28	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C29	250-136		CAPACITOR,FXD,TANT,2.2uf	T354E225M050AS	KEMET
C30	250-19	1	CAPACITOR,FXD,TANT,1UF,10%,35V	196D105X9035HE3	SPRAGUE
CR1	10-1N752A	1	DIODE,ZENER,1N752A,5.6V,5%	1N752A	MOTOROLA
CR2	10-1N4743A	1	DIODE,ZENER,1N4743,13V,10%	1N4743A	MOTOROLA
CR3	10-4	1	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR4	10-1N4446	2	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR5	10-1N4751	1	DIODE,ZENER,1N4751A,30V,5%	1N4751A	MOTOROLA
CR6	10-SI4	8	DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR7	10-SI4		DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR8	10-SI4		DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR9	10-SI4		DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR10	10-SI4		DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR11	10-SI4		DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR12	10-SI4		DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR13	10-SI4		DIODE,RECTIFIER,1N4004,400V,30	SS6253	SEMTECH
CR14	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
P1	551-517	2	CONNECTOR,SOCKET,1ROW-.1"X.1"	100-083-30218-190	TEKA PRODUCTS
P2			NOT ASSIGNED		
P3	551-517		CONNECTOR,SOCKET,1ROW-.1"X.1"	100-083-30218-190	TEKA PRODUCTS
Q1			NOT ASSIGNED		
Q2	20-MPSA42	1	TRANSISTOR,NPN,MPSA42,SI,HIGH	MPSA42	MOTOROLA
Q3	20-MPSA92	4	TRANSISTOR,PNP,MPSA92,SI,HIGH	MPSA92	MOTOROLA
Q4	20-MPSU04	1	TRANSISTOR,NPN,MPSU04,SI,MEDIU	MPSU04	MOTOROLA
Q5			NOT ASSIGNED		
Q6	20-MPSA92		TRANSISTOR,PNP,MPSA92,SI,HIGH	MPSA92	MOTOROLA
Q7	20-MPSA92		TRANSISTOR,PNP,MPSA92,SI,HIGH	MPSA92	MOTOROLA
Q8	20-MPSA92		TRANSISTOR,PNP,MPSA92,SI,HIGH	MPSA92	MOTOROLA
R1	110-316-1	1	RESISTOR,FXD,MF,316,1%,0.25W	SMA-4-316	CORNING
R2	110-5.62K-1		RESISTOR,FXD,MF,5.62K,1%,0.25W	SMA-4-5.62K	CORNING
R3	110-3.83K-1	1	RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4-3.83K	CORNING
R4	110-1.69K-1	2	RESISTOR,FXD,MF,1.69K,1%,0.25W	SMA-4-1.69K	CORNING
R5	110-3.32K-1	2	RESISTOR,FXD,MF,3.32K,1%,0.25W	SMA-4-3.32K	CORNING

Table 5-27. A22 Regulator Interface PCB (6700-D-31722-3; Rev. F) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R6	102-.5-5	3	RESISTOR,FXD,CC,0.5,5%,0.5W	UT-1/2 5% 0.5OHM	
R7	102-.5-5		RESISTOR,FXD,CC,0.5,5%,0.5W	UT-1/2 5% 0.5OHM	
R8	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R9	110-2.21K-1	1	RESISTOR,FXD,MF,2.21K,1%,0.25W	SMA-4-2.21K	CORNING
R10	110-2.15K-1	3	RESISTOR,FXD,MF,2.15K,1%,0.25W	SMA-4-2.15K	CORNING
R11	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R12	110-5.11K-1	2	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R13	110-4.12K-1	1	RESISTOR,FXD,MF,4.12K,1%,0.25W	SMA-4-4.12K	CORNING
R14	110-2.15K-1		RESISTOR,FXD,MF,2.15K,1%,0.25W	SMA-4-2.15K	CORNING
R15	110-1.69K-1		RESISTOR,FXD,MF,1.69K,1%,0.25W	SMA-4-1.69K	CORNING
R16			NOT ASSIGNED		
R17	102-.5-5		RESISTOR,FXD,CC,0.5,5%,0.5W	UT-1/2 5% 0.5ohm	
R18	110-3.32K-1		RESISTOR,FXD,MF,3.32K,1%,0.25W	SMA-4-3.32K	CORNING
R19	110-1.47K-1	1	RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4-1.47K	CORNING
R20	110-7.87K-1	1	RESISTOR,FXD,MF,7.87K,1%,0.25W	SMA-4-7.87K	CORNING
R21	110-2.15K-1		RESISTOR,FXD,MF,2.15K,1%,0.25W	SMA-4-2.15K	CORNING
R22	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R23	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-11K	CORNING
R24	110-16.9K-1	1	RESISTOR,FXD,MF,16.9K,1%,0.25W	SMA-4-16.9K	CORNING
R25	110-90.9K-1	1	RESISTOR,FXD,MF,90.9K,1%,0.25W	SMA-4-90.9K	CORNING
R26	110-49.9K-1	2	RESISTOR,FXD,MF,49.9K,1%,0.25W	SMA-4-49.9K	CORNING
R27	110-49.9K-1		RESISTOR,FXD,MF,49.9K,1%,0.25W	SMA-4-49.9K	CORNING
R28	110-215K-1	1	RESISTOR,FXD,MF,215K,1%,0.25W	SMA-4-215K	CORNING
R29	110-162K-1	1	RESISTOR,FXD,MF,162K,1%,0.25W	SMA-4-162K	CORNING
R30	110-115K-1	1	RESISTOR,FXD,MF,115K,1%,0.25W	SMA-4-115K	CORNING
R31	110-10K-1	2	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R32	110-64.9K-1	2	RESISTOR,FXD,MF,64.9K,1%,0.25W	SMA-4-64.9K	CORNING
R33	110-64.9K-1		RESISTOR,FXD,MF,64.9K,1%,0.25W	SMA-4-64.9K	CORNING
R34	110-45.3K-1	2	RESISTOR,FXD,MF,45.3K,1%,0.25W	SMA-4-45.3K	CORNING
R35	110-45.3K-1		RESISTOR,FXD,MF,45.3K,1%,0.25W	SMA-4-45.3K	CORNING
R36	110-127K-1	2	RESISTOR,FXD,MF,127K,1%,0.25W	SMA-4-127K	CORNING
R37	110-127K-1		RESISTOR,FXD,MF,127K,1%,0.25W	SMA-4-127K	CORNING
R38	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R39	110-147K-1	1	RESISTOR,FXD,MF,147K,1%,0.25W	SMA-4-147K	CORNING
R40	110-75K-1	1	RESISTOR,FXD,MF,75K,1%,0.25W	SMA-4-75K	CORNING
TP1	551-608	1	CONNECTOR SOCKET,1 ROW, 0.150"	66947-013	BERG
U1	54-53	2	IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U2	54-53		IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
VR1			NOT ASSIGNED		
VR2	54-335	1	IC,VOLTAGE REFERENCE,10V	AD581LH	ANALOG DEVICES

Table 5-28. A23 Microprocessor PCB (6700-D-31723-3; Rev. H) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	250-57	1	CAPACITOR,FXD,TANT,150UF,10%,6V	196D157X9006PE3	SPRAGUE
C2	230-37	33	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15			NOT ASSIGNED		
C16	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C19	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C20	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C23	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C24	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C25	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C26	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C27	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C28	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C29	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C30	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C31	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C32	230-70	1	CAPACITOR,FXD,CER,27PF,5%	150-100-NPO-270J	CENTRE
C33	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C34	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C35	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1			NOT ASSIGNED		
CR2	10-1N751A	1	DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
J1	551-148	1	CONNECTOR,DIP SCKT,PCB MNT,18	CA-18S-10SD	CIRCUIT ASSE
L1	310-89	1	INDUCTOR,FIXED,1.9uH @ 50MHz	VK200 10/3B	FERROXCUBE
P1			NOT ASSIGNED		
P2	551-206	1	CONNECTOR,HDR,PC MNT RT ANGL,3	65521-103	BERG
P3	551-236	1	CONNECTOR,DIP SCKT,PC MNT,18	8136-475G9	AUGAT
R1	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R2	110-10K-1	7	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R3	110-100-1	1	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R4	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R5	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R6	110-5.11K-1	2	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R7	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R8	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R9	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R10	110-1K-1	1	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R11	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
RN1	123-9	2	RESISTOR,NETWORK,MF,9X10K,2%	410A103	AB
RN2	123-9		RESISTOR,NETWORK,MF,9X10K,2%	410A103	AB
SW1	420-14	1	SWITCH,SLIDE,2PDT,PC MT VERT	124-441-020	CHICAGO SWITCH
U1	54-317	1	IC,MICROPROCESSOR,8284A	8284A	INTEL
U2	54-74LS73	1	IC,TTL,74LS73,DUAL,JK FLIP FLOP	DM74LS73AN	NSC
U3			NOT ASSIGNED		
U4	54-44	1	IC,TTL,74LS74,DUAL,D FLIP FLOP	DM74LS74AN	NSC

Table 5-28. A23 Microprocessor PCB (6700-D-31723-3; Rev. H) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
U5	54-74LS04	1	IC,TTL,74LS04,HEX,INVERTERS	74LS04PC	FSC
U6	54-113	1	IC,TTL,74LS393,DUAL,4 BIT BINARY	DM74LS393N	NSC
U7	54-212	1	IC,MICROPROCESSOR,8253-5	P8253-5	INTEL
U8	54-316	1	IC,MICROPROCESSOR,8259A	8259A	INTEL
U9	54-315	1	IC,MICROPROCESSOR,8088	8088	INTEL
U10	54-103	2	IC,TTL,74LS373,OCTAL,TRANSPARE	DM74LS373N	NSC
U11	54-103		IC,TTL,74LS373,OCTAL,TRANSPARE	DM74LS373N	NSC
U12	54-74LS01	1	IC,TTL,74LS01,QUAD,2 INPUT NAND	N74LS01N	SIGNETICS
U13	54-57	1	IC,TTL,74LS02,QUAD,2 INPUT NOR	DM74LS02N	NSC
U14	54-534	1	IC,CMOS,74HCT374,OCTAL 3-STATE	MC74HCT374N	MOTOROLA
U15	54-530	2	IC,CMOS,74HCT244,OCTAL	SN74HC244N	TEXAS INSTRUMENTS
U16	54-533	1	IC,CMOS,74HCT373,OCTAL 3-STATE	MC74HCT373N	MOTOROLA
U17	54-530		IC,CMOS,74HCT244,OCTAL	SN74HC244N	TEXAS INSTRUMENTS
U18	54-528	2	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U19	54-528		IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U20	54-74LS139	2	IC,TTL,74LS139,DUAL,2 TO 4 DEC	DM74LS139N	NSC
U21	54-74LS139		IC,TTL,74LS139,DUAL,2 TO 4 DEC	DM74LS139N	NSC
	NOTE: U22 and U23 EPROMS are blank (unprogrammed) memory chips. Please contact a WILTRON Service Representative to aquire the correct replacement firmware revision for your instrument.				
U22	56-20	2	IC,MEMORY,27256,EPROM,32K X 8	HN27256G-25	HITACHI
U23	56-20		IC,MEMORY,27256,EPROM,32K X 8	HN27256G-25	HITACHI
U24	56-7	1	IC,MEMORY,2764-4,EPROM	HN482764G-3	HIT
U25	54-402	1	IC,MEMORY,DS1225/MK48Z08,220NSEC	DS1225Y	DALLAS SEMICONDUCTOR
U26	54-409	2	IC,MEMORY,HM6264LP-15,RAM	HM6264LP-15	HITACHI
U27	54-347	2	IC,MEMORY,EEPROM	2864A	XICOR
U28	54-347		IC,MEMORY,EEPROM	2864A	XICOR
U29	54-409		IC,MEMORY,HM6264LP-15,RAM	HM6264LP-15	HITACHI
U30	54-74LS138	1	IC,TTL,74LS138,3 TO 8 DECODER	SN74LS138N	TEXAS INSTRUMENTS
U31			NOT ASSIGNED		
U32	54-493	1	IC,VOLTAGE COMPARATOR,TL7705A	TL7705ACP	TEXAS INSTRUMENTS
W1			NOT ASSIGNED		
W2	800-140	7	WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
W3	800-140		WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
W4			NOT ASSIGNED		
W5	800-140		WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
W6			NOT ASSIGNED		
W7	800-140		WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
W8			NOT ASSIGNED		
W9	800-140		WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
W10			NOT ASSIGNED		
W11			NOT ASSIGNED		
W12	800-140		WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
W13	800-140		WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES
Y1	630-27	1	CRYSTAL,15MHZ,0.005%	CY15A	CRYSTEK CRYSTAL

Table 5-29. A24 GPIB PCB (6700-D-31724-3; Rev. C) Parts List (Page 1 of 1)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	250-41	1	CAPACITOR,FXD,TANT,6.8UF,10%,3V	196D685X9035KE3	SPRAGUE
C2	230-37	17	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C3	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C4	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C7	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C10	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C11	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C12	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C16	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C17	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C18	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
CR1	10-1N4446	1	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
J1	551-236	1	CONNECTOR,DIP SCKT,PC MNT,18	8136-475G9	AUGAT
L1	310-89	1	INDUCTOR,FIXED,1.9uH @ 50mHz	VK200 10/3B	FERROXCUBE
P1			NOT ASSIGNED		
P2	551-102	1	CONNECTOR,HDR,PC MNT,26 PIN DU	CA-D265P100-230-430	CIRCUIT ASSY
P3	551-206	1	CONNECTOR,HDR,PC MNT RT ANGL,3	65521-103	BERG
R1	110-1K-1	4	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R2	110-75K-1	1	RESISTOR,FXD,MF,75K,1%,0.25W	SMA-4	CORNING
R3	110-10K-1	5	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R4	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R5	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R6	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R7	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R8	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R9	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R10	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
RN1	123-9	1	RESISTOR,NETWORK,MF,9X10K,2%	410A103	AB
S1	420-14	1	SWITCH,SLIDE,2PDT,PC MT VERT	124-441-020	CHICAGO SWITCH
U1	54-93	1	IC,MICROPROCESSOR,8085A	P8085A	INTEL
U2	54-526	1	IC,74HCT04,HEX INVERTERS	CE74HCT04E	RCA
U3	54-74LS01	1	IC,TTL,74LS01,QUAD,2 INPUT NAN	N74LS01N	SIGNETICS
U4	54-529	1	IC,CMOS,74HCT139,DUAL,1OF4	74HCT139N	SUPERTEX INC
U5	54-332	1	IC,TTL,75161A,8 CHANNELS,GPIB	DN75161AN	NSC
U6	54-331	1	IC,TTL,75160A,8 CHANNELS,GPIB	DN75160AN	NSC
U7	54-330	1	IC,TTL,7210,?,GPIB TALKER/LIST	UPD7210C	NEC
U8	54-533	1	IC,CMOS,74HCT373,OCTAL 3-STATE	MC74HCT373N	MOTOROLA
U9	54-527	1	IC,CMOS,74HCT74,DUAL D-TYPE	CD74HCT74E	RCA
U10	54-346	1	IC,MEMORY,27128-3,EPROM	27128-3	INTEL
U11	54-409	1	IC,MEMORY,HM6264LP-15,RAM	HM6264LP-15	HITACHI
U12	54-314	1	IC,MICROPROCESSOR,8255A-5	8255A-5	INTEL
U13	54-528	1	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U14			NOT ASSIGNED		
U15	54-530	1	IC,CMOS,74HCT244,OCTAL	SN74HC244N	TEXAS INSTRUMENTS
U16	54-531	1	IC,CMOS,74HCT245,OCTAL	MC74HCT245N	MOTOROLA
U17	54-74LS00	1	IC,TTL,74LS00,QUAD,2 INPUT NAND	SN74LS00P	MOT
Y1	630-17	1	CRYSTAL,6.000MHZ,+/-0.005%	6.000MHZ	CRYSTEK

Table 5-30. A25 Switching Power Supply PCB (6700-D-31725-3; Rev. J) Parts List (Page 1 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	223-130	1	CAPACITOR,FXD,MICA,130PF,5%,50V	CM04ED131J03	ARCO
C2	230-33	1	CAPACITOR,FXD,CER,2000PF,20%,5V	BGP.002+-20%500VY5U	RMC
C3			NOT ASSIGNED		
C4			NOT ASSIGNED		
C5	250-121	2	CAPACITOR,FIXED,CER,0.01uF	30GAS10	SPRAGUE
C6	250-121		CAPACITOR,FIXED,CER,0.01uF	30GAS10	SPRAGUE
C7			NOT ASSIGNED		
C8	250-85	2	CAPACITOR,FXD,ALUM,12UF,350V	TVA-1605	SPRAGUE
C9	227-50	1	CAPACITOR,FXD,PEST,0.01UF,2%,2V	ZA2C103G	IMB
C10	250-85		CAPACITOR,FXD,ALUM,12UF,350V	TVA-1605	SPRAGUE
C11	220-240	3	CAPACITOR,FXD,MICA,240PF,5%,50V	DM15FD241J03	SUSSCO (ARCO)
C12	230-37	11	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13			NOT ASSIGNED		
C14	220-27	1	CAPACITOR,FXD,MICA,27PF,5%,500V	CD15ED270J03	CORNELL DUBILIER
C15	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C16	227-13	1	CAPACITOR,FXD,MICA,1000PF,2%,1V	CD19FD102G03	CORNELL DUBILIER
C17	250-39	2	CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JE3	SPRAGUE
C18	250-42	3	CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C19	220-470	1	CAPACITOR,FXD,MICA,470PF,5%,50V	DM15FD471J03	SUSSCO (ARCO)
C20	230-3	6	CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C21	250-77	2	CAPACITOR,FXD,CER,0.01UF,10%,1V	CK05BX103K	SPRAGUE
C22	250-77		CAPACITOR,FXD,CER,0.01UF,10%,1V	CK05BX103K	SPRAGUE
C23	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C24	250-40	2	CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X002HE3	SPRAGUE
C25	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C26	250-39		CAPACITOR,FXD,TANT,4.7UF,20%,3V	196D475X0035JE3	SPRAGUE
C27	250-40		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X002HE3	SPRAGUE
C28	250-42		CAPACITOR,FXD,TANT,10UF,10%,25V	196D106X9025KE3	SPRAGUE
C29	230-34	2	CAPACITOR,FXD,CER,2700PF,10%,1V	805-024-Z5F-272K	ERIE
C30	230-34		CAPACITOR,FXD,CER,2700PF,10%,1V	805-024-Z5F-272K	ERIE
C31	210-30	2	CAPACITOR,FXD,PEST,0.10UF,10%	ECQ-E2104KZS	PANASONIC
C32	250-133	2	CAPACITOR,FXD,ALUM,220UF	UPA-1E221M	NICHICON
C33	250-133		CAPACITOR,FXD,ALUM,220UF	UPA-1E221M	NICHICON
C34	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C35	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C36	220-240		CAPACITOR,FXD,MICA,240PF,5%,50V	DM15FD241J03	SUSSCO (ARCO)
C37	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C38	250-134	6	CAPACITOR,FXD,ALUM,47UF	UPAIH470MRH	NICHICON
C39	250-134		CAPACITOR,FXD,ALUM,47UF	UPAIH470MRH	NICHICON
C40	250-135	3	CAPACITOR,FXD,ALUM,10UF	UPA1J100MAH	NICHICON
C41	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C42	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C43	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C44	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C45	250-162		CAPACITOR,FXD,ALUM,22UF,20%	UPA2C220M	NICHICON
C46	250-162		CAPACITOR,FXD,ALUM,22UF,20%	UPA2C220M	NICHICON
C47	250-134		CAPACITOR,FXD,ALUM,47UF	UPAIH470MRH	NICHICON
C48	250-134		CAPACITOR,FXD,ALUM,47UF	UPAIH470MRH	NICHICON
C49	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C50			NOT ASSIGNED		
C51			NOT ASSIGNED		
C52	210-30		CAPACITOR,FXD,PEST,0.10UF,10%	ECQ-E2104KZS	PANASONIC
C53	230-3		CAPACITOR,FXD,CER,1000PF,10%,1V	DD-102	CENTRALAB
C54	250-134		CAPACITOR,FXD,ALUM,47UF	UPAIH470MRH	NICHICON
C55	250-134		CAPACITOR,FXD,ALUM,47UF	UPAIH470MRH	NICHICON
C56	250-135		CAPACITOR,FXD,ALUM,10UF	UPA1J100MAH	NICHICON
C57	250-135		CAPACITOR,FXD,ALUM,10UF	UPA1J100MAH	NICHICON
C58	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C59	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C60	230-8	2	CAPACITOR,FXD,CER,0.02UF,20%,5V	B-GP.02+/-20% 500V	RMC

Table 5-30. A25 Switching Power Supply PCB (6700-D-31725-3; Rev. J) Parts List (Page 2 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C61	230-8		CAPACITOR,FXD,CER,0.02UF,20%,5V	B-GP.02+/-20% 500V	RMC
C62	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C63	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C64	250-19A	1	CAPACITOR,FXD,TANT,1UF,10%,35V	196D-105X9035HA1	SPRAGUE
C65	220-240		CAPACITOR,FXD,MICA,240PF,5%,50V	DMJ15FD241J03	SUSSCO (ARCO)
CR1	10-1N4446	8	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR2	10-78	2	DIODE,ZENER,1N5351B,14V,5%	1N5351B	MOTOROLA
CR3	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR4	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR5	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR6	10-23	2	DIODE,RECTIFIER,IN493G,400V	1N4936	MOTOROLA
CR7	10-23		DIODE,RECTIFIER,IN493G,400V	1N4936	MOTOROLA
CR8	10-1N751A	1	DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR9	10-1N752A	1	DIODE,ZENER,1N752A,5.6V,5%	1N752A	MOTOROLA
CR10	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR11	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR12	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR13	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR14	10-31	2	DIODE,RECTIFIER,1N4934,100V	1N5416	SEMTECH
CR15	10-31		DIODE,RECTIFIER,1N4934,100V	1N5416	SEMTECH
CR16	10-24	1	DIODE ZENER,IN5360A,25V,10%	1N5360A	MOTOROLA
CR17			NOT ASSIGNED		
CR18			NOT ASSIGNED		
CR19	10-78		DIODE,ZENER,1N5351B,14V,5%	1N5351B	MOTOROLA
CR20			NOT ASSIGNED		
CR21			NOT ASSIGNED		
CR22	10-26	4	DIODE,RECTIFIER,MR852,200V	MR852	MOTOROLA
CR23	10-26		DIODE,RECTIFIER,MR852,200V	MR852	MOTOROLA
CR24	10-25	2	DIODE,RECTIFIER,MR854,400V	MR854	MOTOROLA
CR25	10-40	4	DIODE,RECTIFIER,MR822,200V	MR822	MOTOROLA
CR26	10-40		DIODE,RECTIFIER,MR822,200V	MR822	MOTOROLA
CR27	10-25		DIODE,RECTIFIER,MR854,400V	MR854	MOTOROLA
CR28	10-26		DIODE,RECTIFIER,MR852,200V	MR852	MOTOROLA
CR29	10-26		DIODE,RECTIFIER,MR852,200V	MR852	MOTOROLA
CR30	10-40		DIODE,RECTIFIER,MR822,200V	MR822	MOTOROLA
CR31	10-40		DIODE,RECTIFIER,MR822,200V	MR822	MOTOROLA
CR32	15-18	1	INDICATOR,LED,RED	550-0406	DIALIGHT
L1	A30511	1	INDUCTOR,FXD,17.6uh/7.3A		WEST COAST MAGNETICS
L2-L12			NOT ASSIGNED		
L13	A32372	2	INDUCTOR FILTER,SWITCHER		WEST COAST MAGNETICS
L14	A32372		INDUCTOR FILTER,SWITCHER		WEST COAST MAGNETICS
L15	310-53	1	INDUCTOR,FXD,47.0UH,5%	1537-60	DELEVAN
L16	310-98	1	INDUCTOR,FXD,1mH,10%	1537-744	DELEVAN
L17	310-35	1	INDUCTOR,FXD,10mH,10%	MR10000	LENOX-FUGEL
Q1	20-9	1	TRANSISTOR,PNP,2N4249,SI	2N4249	CDI
Q2	20-2N3694	3	TRANSISTOR,NPN,2N3694,SI,GEN PURP	MPS3694-18	MOTOROLA
Q3	20-2N2222A	2	TRANSISTOR,NPN,2N2222A,SI	2N2222A	MOTOROLA
Q4	20-2N2905	2	TRANSISTOR,PNP,2N2905,SI	2N2905	MOTOROLA
Q5	20-2N2905		TRANSISTOR,PNP,2N2905,SI	2N2905	MOTOROLA
Q6			NOT ASSIGNED		
Q7			NOT ASSIGNED		
Q8	20-2N2907A	1	TRANSISTOR,PNP,2N2907A,SI	2N2907A	MOTOROLA
Q9	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI	2N2222A	MOTOROLA
Q10	20-2N3694		TRANSISTOR,NPN,2N3694,SI,GEN PURP	MPS3694-18	MOTOROLA
Q11	20-2N3694		TRANSISTOR,NPN,2N3694,SI,GEN PURP	MPS3694-18	MOTOROLA
Q12	20-2N3904		TRANSISTOR,NPN,2N3904,SI,GEN PURP	2N3905	MOTOROLA
R1	110-6.19K-1	2	RESISTOR,FXD,MF,6.19K,1%,0.25W	SMA-4-6.19K	CORNING
R2	110-6.19K-1		RESISTOR,FXD,MF,6.19K,1%,0.25W	SMA-4-6.19K	CORNING
R3	102-.5-5	2	RESISTOR,FXD,CC,0.5,5%,0.5W	UT-1/2 5% 0.5ohm	VERMONT PRECISION
R4	110-365-1	2	RESISTOR,FXD,MF,365,1%,0.25W	SMA-4-365	CORNING

Table 5-30. A25 Switching Power Supply PCB (6700-D-31725-3; Rev. J) Parts List (Page 3 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R5	102-100K-5	2	RESISTOR,FXD,CC,100K,5%,0.5W	RC20GF104J	ALLEN BRADLEY
R6			NOT ASSIGNED		
R7	110-365-1		RESISTOR,FXD,MF,365,1%,0.25W	SMA-4-365	CORNING
R8	102-.5-5		RESISTOR,FXD,CC,0.5,5%,0.5W	UT-1/2 5% 0.5ohm	VERMONT PRECISION
R9	113-4.84K-0.1	1	RESISTOR,FXD,MF,4.84K,0.1%,0.1W	RN55C,4.8K,.1%	VERMONT PRECISION
R10	110-1K-1	7	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R11	113-4.99K-0.1	1	RESISTOR,FXD,MF,4.99K,0.1%,0.1W	RN55C,4.8K,.1%	VERMONT PRECISION
R12	110-22.1K-1	2	RESISTOR,FXD,MF,22.1K,1%,0.25W	SMA-4-22.1K	CORNING
R13	110-42.2K-1	1	RESISTOR,FXD,MF,42.2K,1%,0.25W	SMA-4-42.2K	CORNING
R14			NOT ASSIGNED		
R15	110-100-1	2	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R16	110-22.1K-1		RESISTOR,FXD,MF,22.1K,1%,0.25W	SMA-4-22.1K	CORNING
R17	110-1.87K-1	1	RESISTOR,FXD,MF,1.87K,1%,0.25W	SMA-4-1.87K	CORNING
R18	110-3.16K-1	1	RESISTOR,FXD,MF,3.16K,1%,0.25W	SMA-4-3.16K	CORNING
R19	110-24.9K-1	1	RESISTOR,FXD,MF,24.9K,1%,0.25W	SMA-4-24.9K	CORNING
R20	156-5K	1	RESISTOR,TRIM,CER,5K,10%,1T	72XWR-5K	BECKMAN
R21	110-8.45K-1	1	RESISTOR,FXD,MF,8.45K,1%,0.25W	SMA-4-8.45K	CORNING
R22	110-13.3K-1	1	RESISTOR,FXD,MF,13.3K,1%,0.25W	SMA-4-13.3K	CORNING
R23	110-6.81K-1	1	RESISTOR,FXD,MF,6.81K,1%,0.25W	SMA-4-6.81K	CORNING
R24	110-10K-1	8	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R25	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R26	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R27	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R28	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R29	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R30	110-28.7-1	2	RESISTOR,FXD,MF,28.7,1%,0.25W	SMA-4-28.7	CORNING
R31	110-261-1	2	RESISTOR,FXD,MF,261,1%,0.25W	SMA-4-261	CORNING
R32	110-28.7-1		RESISTOR,FXD,MF,28.7,1%,0.25W	SMA-4-28.7	CORNING
R33	110-261-1		RESISTOR,FXD,MF,261,1%,0.25W	SMA-4-261	CORNING
R34	104-750-5	2	RESISTOR,FXD,CC,750,5%,2W	RC42GF751J	ALLEN BRADLEY
R35	104-750-5		RESISTOR,FXD,CC,750,5%,2W	RC42GF751J	ALLEN BRADLEY
R36	110-68.1-1	1	RESISTOR,FXD,MF,68.1,1%,0.25W	SMA-4-68.1	CORNING
R37	110-19.6-1	1	RESISTOR,FXD,MF,19.6,1%,0.25W	SMA-4-19.6	CORNING
R38	110-249-1	1	RESISTOR,FXD,MF,249,1%,0.25W	SMA-4-249	CORNING
R39	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R40	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R41	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R42	101-2.2M-5	1	RESISTOR,FXD,CC,2.2M,5%,0.25W	RC07GF225J	ALLEN BRADLEY
R43	110-48.7K-1	1	RESISTOR,FXD,MF,48.7K,1%,0.25W	SMA-4-48.7K	CORNING
R44	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R45	110-1.47K-1	1	RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4-1.47K	CORNING
R46	110-14.7K-1	1	RESISTOR,FXD,MF,14.7K,1%,0.25W	SMA-4-14.7K	CORNING
R47	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R48	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R49	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R50	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R51	110-147-1	1	RESISTOR,FXD,MF,147,1%,0.25W	SMA-4-147	CORNING
R52	110-750K-1	1	RESISTOR,FXD,MF,750K,1%,0.25W	SMA-4-750K	CORNING
R53	110-499-1	2	RESISTOR,FXD,MF,499,1%,0.25W	SMA-4-499	CORNING
R54	110-100K-1	1	RESISTOR,FXD,MF,100K,1%,0.25W	SMA-4-100K	CORNING
R55	110-499-1		RESISTOR,FXD,MF,499,1%,0.25W	SMA-4-499	CORNING
R56	110-10-1	4	RESISTOR,FXD,MF,10,1%,0.25W	SMA-4-10	CORNING
R57	110-10-1		RESISTOR,FXD,MF,10,1%,0.25W	SMA-4-10	CORNING
R58	110-402-1	1	RESISTOR,FXD,MF,402,1%,0.25W	SMA-4-402	CORNING
R59	110-24.9-1	1	RESISTOR,MF,1/4W,1%	SMA-4-24.9	CORNING
R60	110-10-1		RESISTOR,FXD,MF,10,1%,0.25W	SMA-4-10	CORNING
R61	110-3.24-1		RESISTOR,FXD,MF,3.24,1%,0.25W	SMA-4-3.24	CORNING
R62	110-51.1-1	1	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R63			NOT ASSIGNED		
R64	110-61.9-1	2	RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4-61.9	CORNING

Table 5-30. A25 Switching Power Supply PCB (6700-D-31725-3; Rev. J) Parts List (Page 4 of 4)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R65	110-121-1	1	RESISTOR,FXD,MF,121,1%,0.25W	SMA-4-121	CORNING
R66			NOT ASSIGNED		
R67			NOT ASSIGNED		
R68			NOT ASSIGNED		
R69			NOT ASSIGNED		
R70	110-5.11K-1	1	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R71	110-61.9-1		RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4-61.9	CORNING
R72	110-31.6K-1	1	RESISTOR,FXD,MF,31.6K,1%,0.25W	SMA-4-31.6K	CORNING
R73	110-10-1	1	RESISTOR,FXD,MF,10,1%,0.25W	SMA-4-10	CORNING
R74	110-15-1	1	RESISTOR,FXD,MF,15,1%,0.25W	SMA-4-15	CORNING
R75	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R76	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R77	110-26.1-1	1	RESISTOR,FXD,MF,26.1,1%,0.25W	SMA-4-26.1	CORNING
R78	110-1.96K-1	1	RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R79	110-332-1	1	RESISTOR,FXD,MF,332,1%,0.25W	SMA-4-332	CORNING
RT1	35-1	1	THERMISTOR,NTC,1.0M,05%,0.1W	12C1004-5	WESTERN THERMISTOR
T1			NOT ASSIGNED		
T2			NOT ASSIGNED		
T3	320-96	1	TRANSFORMER,POWER,50kHZ	B34052	WEST COAST MAGNETICS
TP1	551-674	2	CONNECTOR SOCKET	66947-003	BERG
TP2	551-674		CONNECTOR SOCKET	66947-003	BERG
TP3	551-674		CONNECTOR SOCKET	66947-003	BERG
TP4	551-674		CONNECTOR SOCKET	66947-003	BERG
TP5	551-674		CONNECTOR SOCKET	66947-003	BERG
TP6	551-674		CONNECTOR SOCKET	66947-003	BERG
U1	20-820	2	OPTOCOUPLER,GEN PURPOSE,NPN,MC	MCT-2E	MONSANTO
U2	20-820		OPTOCOUPLER,GEN PURPOSE,NPN,MC	MCT-2E	MONSANTO
U3	50-33	1	IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U4	54-140	1	IC,OP AMP,MC3420,SINGLE	MC3420P	MOTOROLA
U5	54-555	1	IC,OP AMP,NE555,SINGLE	LM555CN	RCA
VR1	54-LM340T	1	IC,VOLTAGE REGULATOR,LM340	LM340T-12	NSC
VR2	54-335	1	IC,VOLTAGE REFERENCE,10V	AD581LH	ANALOG DEVICES

Table 5-31. A26 Line Filter PCB (6700-D-31726-3; Rev. B) Parts List (Page 1 of 1)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1		2	CAPACITOR,FXD,1.0UF,400V		
C2			CAPACITOR,FXD,1.0UF,400V		
RT1	35-7	2	THERMISTOR,NTC,5.00,10%,2.0W	50B5R00K	CAL-R
RT2	35-7		THERMISTOR,NTC,5.00,10%,2.0W	50B5R00K	CAL-R
RV1	35-14	2	VARISTOR,150VRMS,0.6W	V150LA10A	G.E.
RV2	35-14		VARISTOR,150VRMS,0.6W	V150LA10A	G.E.

Table 5-32. A27 Aux I/O PCB (6700-D-31727-3; Rev. C) Parts List (Page 1 of 1)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
CR1	10-1N4446	2	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR2	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
J1	551-579	1	CONNECTOR,RACK & PNL,SUB MIN	745114-1	AMP
J2	551-556	1	CONNECTOR,HEADER,2 ROW-0.10"X	67997-114	BERG
K1	690-38	2	RELAY,LATCHING,2C,5VDC	DS2ES-DC5V	AROMAT
K2	690-38		RELAY,LATCHING,2C,5VDC	DS2ES-DC5V	AROMAT
Q1	20-2N4249	2	TRANSISTOR,PNP,2N4249,SI,LOW N	MPS4249-18	MOTOROLA
Q2	20-2N4249		TRANSISTOR,PNP,2N4249,SI,LOW N	MPS4249-18	MOTOROLA
R1	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R2	110-10K-1	2	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
R3	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4	CORNING
R4	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4	CORNING
S1	430-229	1	SWITCH,DIP,16 PIN,ROCKER,9	1-435802-9	AMP

Table 5-33. A28 Motherboard PCB (6700-D-31828-3; Rev. A) Parts List (Page 1 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	230-40	2	CAPACITOR,FXD,CER,0.01UF,20%,1V	5GA-S10	SPRAGUE
C2	230-40		CAPACITOR,FXD,CER,0.01UF,20%,1V	5GA-S10	SPRAGUE
C3			NOT ASSIGNED		
C4			NOT ASSIGNED		
C5	250-144	1	CAPACITOR,FXD,ALUM,1500UF,20%	ULB1H152M	NICHICON
C6	250-19A	2	CAPACITOR,FXD,TANT,1UF,10%,35V	196D-105X9035HA1	SPRAGUE
C7	230-37	1	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	250-19A		CAPACITOR,FXD,TANT,1UF,10%,35V	196D-105X9035HA1	SPRAGUE
CR1			NOT ASSIGNED		
CR2			NOT ASSIGNED		
CR3			NOT ASSIGNED		
CR4			NOT ASSIGNED		
CR5	10-SI2	1	DIODE,RECTIFIER,IN4003,200V	SS6253	SEMTECH
CR6			NOT ASSIGNED		
CR7			NOT ASSIGNED		
CR8			NOT ASSIGNED		
CR9			NOT ASSIGNED		
CR10	10-1N4743A	2	DIODE,ZENER,1N4743,13V,10%	1N4743A	MOTOROLA
CR11	10-1N4743A		DIODE,ZENER,1N4743,13V,10%	1N4743A	MOTOROLA
CR12	10-1N4446	1	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
FL1	260-7	1	EMI FILTER,BALANCED,SOLDER	3EZP	CORCOM
J1	551-561	1	CONNECTOR HEADER,1ROW-0.10"	65595-111	BERG
J2	551-560	1	CONNECTOR,HEADER,1 ROW-0.10"	65595-104	BERG
J3	551-552	2	CONNECTOR HEADER,1 ROW-0.10"	68016-104	BERG
J4	551-552		CONNECTOR HEADER,1 ROW-0.10"	68016-104	BERG
J5	551-551	5	CONNECTOR HEADER,1 ROW-0.10"	68016-103	BERG
J6	551-551		CONNECTOR HEADER,1 ROW-0.10"	68016-103	BERG
J7	551-551		CONNECTOR HEADER,1 ROW-0.10"	68016-103	BERG
J8	551-551		CONNECTOR HEADER,1 ROW-0.10"	68016-103	BERG
J9	551-553	1	CONNECTOR HEADER,1 ROW-0.10"	68492-106	BERG
J10	551-707	5	CONNECTOR,HDR,1 ROW-0.10",PC	69167-103	BERG
J11	551-707		CONNECTOR,HDR,1 ROW-0.10",PC	69167-103	BERG
J12	551-605	2	CONNECTOR,HDR,1 ROW-0.10"	68002-104	BERG
J13	551-605		CONNECTOR,HDR,1 ROW-0.10"	68002-104	BERG
J14	551-554	1	CONNECTOR HEADER,2 ROW-0.10"	68492-114	BERG
J15			NOT ASSIGNED		
J16			NOT ASSIGNED		
J17			NOT ASSIGNED		
J18			NOT ASSIGNED		
J19	551-603	2	CONNECTOR,HDR,2 ROW-0.10"X0.10	68492-126	BERG
J20	551-707		CONNECTOR HEADER,1 ROW-,0.10",PC	69167-103	BERG
J21	551-707		CONNECTOR,HDR,1 ROW-0.10",PC	69167-103	BERG
J22	551-707		CONNECTOR,HDR,1 ROW-0.10",PC	69167-103	BERG
J23	551-603		CONNECTOR,HDR,2 ROW-0.10"X0.10	68492-126	BERG
J24	551-551		CONNECTOR HEADER,1 ROW-0.10"	68016-103	BERG
J25	551-586	1	CONNECTOR,HEADER,2 ROW-0.1"X	68492-124	BERG
J26	551-600	1	CONNECTOR HEADER,1 ROW-.20"	10-63-1063	MOLEX
J27	551-607	1	CONNECTOR,HEADER,2 ROW-.1"X.1"	68492-130	BERG
K1	690-47	1	RELAY,CRADLE,3C,24VDC,650,SING	LY30-US-DC24	OMRON
Q1	20-45	1	TRANSISTOR,FET,N CHANNEL ENH	VN10KM	SILICONIX
Q2	20-2N2222A	1	TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q3	20-2N3694	1	TRANSISTOR,NPN,2N3694,SI,GEN P	MPS3694-18	MOTOROLA
Q4	20-2N6041	1	TRANSISTOR,PNP,2N6041,SI,DARLI	2N6041	MOTOROLA
R1	102-100K-5	2	RESISTOR,FXD,CC,100K,5%,0.5W	RC20GF104J	ALLEN BRADLEY
R2	102-100K-5		RESISTOR,FXD,CC,100K,5%,0.5W	RC20GF104J	ALLEN BRADLEY
R3	110-3.83K-1	1	RESISTOR,FXD,MF,3.83K,1%,0.25W	SMA-4-3.83K	CORNING
R4	110-53.6K-1	1	RESISTOR,FXD,MF,53.6K,1%,0.25W	SMA-4-53.6K	CORNING
R5	110-4.99K-1	1	RESISTOR,FXD,MF,4.99K,1%,0.25W	SMA-4-4.99K	CORNING
R6	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R7	110-15K-1	1	RESISTOR,FXD,MF,15K,1%,0.25W	SMA-4-15K	CORNING

Table 5-33. A28 Motherboard PCB (6700-D-31828-3; Rev. A) Parts List (Page 2 of 2)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R8	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R9			NOT ASSIGNED		
R10			NOT ASSIGNED		
R11	110-316-1	1	RESISTOR,FXD,MF,316,1%,0.25W	SMA-4-316	CORNING
R12	110-5.62K-1	1	RESISTOR,FXD,MF,5.62K,1%,0.25W	SMA-45.62K	CORNING
XA1			NOT ASSIGNED		
XA2			NOT ASSIGNED		
XA3			NOT ASSIGNED		
XA4			NOT ASSIGNED		
XA5			NOT ASSIGNED		
XA6P1			NOT ASSIGNED		
XA6P2			NOT ASSIGNED		
XA7			NOT ASSIGNED		
XA8	551-503	5	CONNECTOR,CARD EDGE,PRESS FIT	NK20A-1-1-192	WINCHESTER
XA9			NOT ASSIGNED		
XA10			NOT ASSIGNED		
XA11P1			NOT ASSIGNED		
XA11P2			NOT ASSIGNED		
XA12			NOT ASSIGNED		
XA13			NOT ASSIGNED		
XA14			NOT ASSIGNED		
XA15	551-501	5	CONNECTOR,CARD EDGE,PRESS FIT	NK25A-1-1-192	WINCHESTER
XA16	551-501		CONNECTOR,CARD EDGE,PRESS FIT	NK25A-1-1-192	WINCHESTER
XA17	551-502	1	CONNECTOR,CARD EDGE,PRESS FIT	NK35A-1-1-192	WINCHESTER
XA18			NOT ASSIGNED		
XA19			NOT ASSIGNED		
XA20			NOT ASSIGNED		
XA21			NOT ASSIGNED		
XA22			NOT ASSIGNED		
XA23			NOT ASSIGNED		
XA24			NOT ASSIGNED		
XA25P1			NOT ASSIGNED		
XA25P2			NOT ASSIGNED		
XA27			NOT ASSIGNED		
XA14			NOT ASSIGNED		

Table 5-34. A29 Rear Panel Interface PCB (6700-D-31729-3; Rev. H) Parts List (Page 1 of 6)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
C1	250-40A	19	CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C2	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C3	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C4	230-37	19	CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C5	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C6			NOT ASSIGNED		
C7	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C8	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C9	230-11	1	CAPACITOR,FXD,CER,0.01UF,+80/-20	TCP-R01	ARCO/SOSHIN
C10	250-143	2	CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C11	230-64	1	CAPACITOR,FXD,1000pF,+/-5%	200-100-NPO-102J	CENTRE ENG
C12	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C13	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C14	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C15	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C16	250-143		CAPACITOR,FXD,CER,180pF,5%,100V	150-100-NPO-181J	CENTRE ENG
C17	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C18	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C19	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C20	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C21	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C22	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C23	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C24	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C25	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C26	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C27	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C28	230-70	1	CAPACITOR,FIXED,CER,27pf,5%	150-100-NPO-270J	CENTRE ENG
C29	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C30	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C31	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C32	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C33	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C34	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C35	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C36	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C37	250-40A		CAPACITOR,FXD,TANT,2.2UF,20%,2V	196D225X0025HA1	SPRAGUE
C38			NOT ASSIGNED		
C39			NOT ASSIGNED		
C40			NOT ASSIGNED		
C41			NOT ASSIGNED		
C42			NOT ASSIGNED		
C43			NOT ASSIGNED		
C44			NOT ASSIGNED		
C45	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C46	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C47			NOT ASSIGNED		
C48	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C49	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C50	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C51	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C52	230-37		CAPACITOR,FXD,CER,0.1UF,20%,10V	RPE122104M100V	MURATA/ERIE
C53	230-74	4	CAPACITOR,FXD,CER,5PF,5%	200-100-NPO-5R0J	CENTRE ENG
C54	230-74		CAPACITOR,FXD,CER,5PF,5%	200-100-NPO-5R0J	CENTRE ENG
C55	230-74		CAPACITOR,FXD,CER,5PF,5%	200-100-NPO-5R0J	CENTRE ENG
C56	230-74		CAPACITOR,FXD,CER,5PF,5%	200-100-NPO-5R0J	CENTRE ENG
CR1	10-1N751A	9	DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR2	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR3	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR4	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA

Table 5-34. A29 Rear Panel Interface PCB (6700-D-31729-3; Rev. H) Parts List (Page 2 of 6)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
CR5	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR6	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR7			NOT ASSIGNED		
CR8	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR9			NOT ASSIGNED		
CR10			NOT ASSIGNED		
CR11	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
CR12	10-4	3	DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR13	10-1N759A	1	DIODE,ZENER,1N759A,12V,5%	1N759A	FSC
CR14	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR15			NOT ASSIGNED		
CR16	10-4		DIODE,SCHOTTKY MIXER,MBD501	MBD501	MOTOROLA
CR17			NOT ASSIGNED		
CR18			NOT ASSIGNED		
CR19			NOT ASSIGNED		
CR20			NOT ASSIGNED		
CR21			NOT ASSIGNED		
CR22	10-1N4446	20	DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR23	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR24	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR25	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR26	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR27	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR28	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR29	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR30	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR31	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR32	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR33	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR34	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR35	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR36	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR37	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR38	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR39	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR40	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR41	10-1N4446		DIODE,SWITCHING,1N4446,75V,4NS	1N4446 T+R	BELL
CR42	10-FD300	7	DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR43	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR44	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR45	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR46	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR47	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR48	10-FD300		DIODE RECTIFIER,IN3595,125V,4A	1N3595	SOLID STATE
CR49	10-1N751A		DIODE,ZENER,1N751A,5.1V,5%	1N751A	MOTOROLA
J1	551-707	4	CONN,HEADER,1 ROW,.100",PC	69167-103	BERG-DU PONT
J2	551-707		CONN,HEADER,1 ROW,.100",PC	69167-103	BERG-DU PONT
J3	551-707		CONN,HEADER,1 ROW,.100",PC	69167-103	BERG-DU PONT
J4	551-707		CONN,HEADER,1 ROW,.100",PC	69167-103	BERG-DU PONT
J5			NOT ASSIGNED		
J6	551-548	4	CONNECTOR HEADER,1 ROW-0.10"	68001-106	BERG
J7	551-548		CONNECTOR HEADER,1 ROW-0.10"	68001-106	BERG
J8	551-548		CONNECTOR HEADER,1 ROW-0.10"	68001-106	BERG
J9	551-548		CONNECTOR HEADER,1 ROW-0.10"	68001-106	BERG
J10	551-706	1	CONNECTOR,HEADER,PCB MNT	CA-D10SP100-180-400	CIRCUIT ASSY
J11	551-557	2	CONNECTOR,HEADER,1 ROW-0.10"	68001-104	BERG
J12	551-557		CONNECTOR,HEADER,1 ROW-0.10"	68001-104	BERG
L1	310-89	2	INDUCTOR,FIXED,1.9uH @ 50mHz	VK200 10/3B	FERROXCUBE
L2	310-89		INDUCTOR,FIXED,1.9uH @ 50mHz	VK200 10/3B	FERROXCUBE
L3	310-45	1	INDUCTOR,FXD,100.0UH,5%	1315-12J	AIRCO

Table 5-34. A29 Rear Panel Interface PCB (6700-D-31729-3; Rev. H) Parts List (Page 3 of 6)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
L6	310-53	1	INDUCTOR,FXD,47.0UH,+-5%	1537-60	DELEVAN
P1	551-542	1	CONNECTOR,PCB TRANSISTOR TYPE	FCN-754PO14-AU/O	FUJITSU
P2	551-362	2	CONNECTOR,INSULATION DIS	3926-000T	3M
P3	551-362		CONNECTOR,INSULATION DIS	3926-000T	3M
Q1	20-2N2907A	2	TRANSISTOR,PNP,2N2907A,SI,MED	2N2907A	MOTOROLA
Q2	20-2N2907A		TRANSISTOR,PNP,2N2907A,SI,MED	2N2907A	MOTOROLA
Q3	20-2N2222A	10	TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q4	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q5	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q6	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q7	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q8	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q9	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
Q10	20-2N2222A		TRANSISTOR,NPN,2N2222A,SI,MED	2N2222A	MOTOROLA
R1	110-100-1	31	RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R2	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R3	110-34.8K-1	3	RESISTOR,FXD,MF,34.8K,1%,0.25W	SMA-4-34.8K	CORNING
R4	110-30.1K-1		RESISTOR,FXD,MF,30.1K,1%,0.25W	SMA-4-30.1K	CORNING
R5	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R6	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R7	110-34.8K-1		RESISTOR,FXD,MF,34.8K,1%,0.25W	SMA-4-34.8K	CORNING
R8	110-30.1K-1		RESISTOR,FXD,MF,30.1K,1%,0.25W	SMA-4-30.1K	CORNING
R9	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R10	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R11	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R12	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R13	110-34.8K-1		RESISTOR,FXD,MF,34.8K,1%,0.25W	SMA-4-100	CORNING
R14	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R15	110-30.1K-1		RESISTOR,FXD,MF,30.1K,1%,0.25W	SMA-4-30.1K	CORNING
R16	110-30.1K-1		RESISTOR,FXD,MF,30.1K,1%,0.25W	SMA-4-30.1K	CORNING
R17	110-30.1K-1		RESISTOR,FXD,MF,30.1K,1%,0.25W	SMA-4-30.1K	CORNING
R18	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R19	110-12.7K-1	1	RESISTOR,FXD,MF,12.7K,1%,0.25W	SMA-4-12.7K	CORNING
R20	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R21	110-16.2-1	1	RESISTOR,FXD,MF,16.2,1%,0.25W	SMA-4-16.2	CORNING
R22	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R23	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R24	110-5.11K-1	2	RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
R25	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R26	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R27	110-10K-1	21	RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R28	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R29	110-20.5K-1	1	RESISTOR,FXD,MF,20.5K,1%,0.25W	SMA-4-20.5K	CORNING
R30	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R31	110-20K-1	2	RESISTOR,FXD,MF,20K,1%,0.25W	SMA-4-20K	CORNING
R32	110-20K-1		RESISTOR,FXD,MF,20K,1%,0.25W	SMA-4-20K	CORNING
R33	110-102K-1	1	RESISTOR,FXD,MF,102K,1%,0.25W	SMA-4-102K	CORNING
R34	110-205K-1	1	RESISTOR,FXD,MF,205K,1%,0.25W	SMA-4-205K	CORNING
R35	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R36	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R37	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R38	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R39	110-48.7-1	8	RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R40	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R41	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R42	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R43	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R44	110-33.2-1	2	RESISTOR,FXD,MF,33.2,1%,0.25W	SMA-4-33.2	CORNING
R45	110-33.2-1		RESISTOR,FXD,MF,33.2,1%,0.25W	SMA-4-33.2	CORNING
R46	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING

Table 5-34. A29 Rear Panel Interface PCB (6700-D-31729-3; Rev. H) Parts List (Page 4 of 6)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R47	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R48	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R49	110-215-1	8	RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R50	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R51	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R52	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R53	110-133-1	4	RESISTOR,FXD,MF,133,1%,0.25W	SMA-4-133	CORNING
R54	110-133-1		RESISTOR,FXD,MF,133,1%,0.25W	SMA-4-133	CORNING
R55	110-61.9-1	3	RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4-61.9	CORNING
R56	110-61.9-1		RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4-61.9	CORNING
R57	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R58	110-215-1		RESISTOR,FXD,FM,215,1%,0.25W	SMA-4-215	CORNING
R59	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R60	110-215-1		RESISTOR,FXD,MF,215,1%,0.25W	SMA-4-215	CORNING
R61	110-133-1		RESISTOR,FXD,MF,133,1%,0.25W	SMA-4-133	CORNING
R62	110-133-1		RESISTOR,FXD,MF,133,1%,0.25W	SMA-4-133	CORNING
R63	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R64	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R65	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R66	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R67	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R68	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R69	110-51.1-1	3	RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R70	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R71	110-51.1-1		RESISTOR,FXD,MF,51.1,1%,0.25W	SMA-4-51.1	CORNING
R72	110-61.9-1		RESISTOR,FXD,MF,61.9,1%,0.25W	SMA-4-61.9	CORNING
R73			NOT ASSIGNED		
R74			NOT ASSIGNED		
R75			NOT ASSIGNED		
R76			NOT ASSIGNED		
R77			NOT ASSIGNED		
R78			NOT ASSIGNED		
R79			NOT ASSIGNED		
R80			NOT ASSIGNED		
R81	110-4.87K-1	4	RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R82	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R83	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R84	110-4.87K-1		RESISTOR,FXD,MF,4.87K,1%,0.25W	SMA-4-4.87K	CORNING
R85	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R86	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R87	110-3.01K-1	2	RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R88	110-1.96K-1	5	RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R89	110-1.47K-1	2	RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4-1.47K	CORNING
R90	110-1.47K-1		RESISTOR,FXD,MF,1.47K,1%,0.25W	SMA-4-1.47K	CORNING
R91	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R92	110-48.7-1		RESISTOR,FXD,MF,48.7,1%,0.25W	SMA-4-48.7	CORNING
R93	110-511-1	1	RESISTOR,FXD,MF,511,1%,0.25W	SMA-4-511	CORNING
R94	110-66.5K-1	1	RESISTOR,FXD,MF,66.5K,1%,0.25W	SMA-4-66.5K	CORNING
R95	110-95.3K-1	1	RESISTOR,FXD,MF,95.3K,1%,0.25W	SMA-4-95.3K	CORNING
R96	110-14.7K-1	1	RESISTOR,FXD,MF,14.7K,1%,0.25W	SMA-4-14.7K	CORNING

Table 5-34. A29 Rear Panel Interface PCB (6700-D-31729-3; Rev. H) Parts List (Page 5 of 6)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
R97	110-301K-1	1	RESISTOR,FXD,MF,301K,1%,0.25W	SMA-4-301	CORNING
R98	110-909-1	1	RESISTOR,FXD,MF,909,1%,0.25W	SMA-4-909	CORNING
R99	110-1K-1	2	RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R100	110-3.01K-1		RESISTOR,FXD,MF,3.01K,1%,0.25W	SMA-4-3.01K	CORNING
R101	110-1.87K-1	4	RESISTOR,FXD,MF,1.87K,1%,0.25W	SMA-4-1.87K	CORNING
R102	110-1.87K-1		RESISTOR,FXD,MF,1.87K,1%,0.25W	SMA-4-1.87K	CORNING
R103	110-1.87K-1		RESISTOR,FXD,MF,1.87K,1%,0.25W	SMA-4-1.87K	CORNING
R104	110-1.87K-1		RESISTOR,FXD,MF,1.87K,1%,0.25W	SMA-4-1.87K	CORNING
R105	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R106	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R107	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R108	110-1.96K-1		RESISTOR,FXD,MF,1.96K,1%,0.25W	SMA-4-1.96K	CORNING
R109	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R110	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R111	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R112	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R113	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R114	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R115	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R116	110-100-1		RESISTOR,FXD,MF,100,1%,0.25W	SMA-4-100	CORNING
R117	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R118	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R119	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R120	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R121	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R122	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R123	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R124	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R125	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R126	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R127	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R128	110-10K-1		RESISTOR,FXD,MF,10K,1%,0.25W	SMA-4-10K	CORNING
R129	103-240-5	4	RESISTOR,FXD,CC,240,5%,1W	RC32GF241J	ALLEN BRADLEY
R130	103-240-5		RESISTOR,FXD,CC,240,5%,1W	RC32GF241J	ALLEN BRADLEY
R131	103-240-5		RESISTOR,FXD,CC,240,5%,1W	RC32GF241J	ALLEN BRADLEY
R132	103-240-5		RESISTOR,FXD,CC,240,5%,1W	RC32GF241J	ALLEN BRADLEY
R133	110-22.1-1	4	RESISTOR,FXD,MF,22.1,1%,0.25W	SMA-4-22.1	CORNING
R134	110-22.1-1		RESISTOR,FXD,MF,22.1,1%,0.25W	SMA-4-22.1	CORNING
R135	110-22.1-1		RESISTOR,FXD,MF,22.1,1%,0.25W	SMA-4-22.1	CORNING
R136	110-22.1-1		RESISTOR,FXD,MF,22.1,1%,0.25W	SMA-4-22.1	CORNING
R137	110-1K-1		RESISTOR,FXD,MF,1K,1%,0.25W	SMA-4-1K	CORNING
R138	110-5.11K-1		RESISTOR,FXD,MF,5.11K,1%,0.25W	SMA-4-5.11K	CORNING
RN1	123-6	4	RESISTOR,NETWORK,MF,7X10K,2%	4308R-101-103	BOURNS
RN2	123-6		RESISTOR,NETWORK,MF,7X10K,2%	4308R-101-103	BOURNS
RN3	123-15	2	RESISTOR,NETWORK,MF,7X4.7K,2%	4308R-101-472	BOURNS
RN4	123-15		RESISTOR,NETWORK,MF,7X4.7K,2%	4308R-101-472	BOURNS
RN5	123-6		RESISTOR,NETWORK,MF,7X10K,2%	4308R-101-103	BOURNS
RN6	123-6		RESISTOR,NETWORK,MF,7X10K,2%	4308R-101-103	BOURNS
U1	54-530	2	IC,CMOS,74HCT244,OCTAL	SN74HC244N	TEXAS INSTRUMENTS
U2	54-524	1	IC,CMOS,74HCT00,QUAD 2-INPUT	MC74HCT00N	MOTOROLA
U3	54-530		IC,CMOS,74HCT244,OCTAL	SN74HC244N	TEXAS INSTRUMENTS
U4	54-523	6	IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U5	54-132	2	IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U6	54-528	2	IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U7	54-528		IC,CMOS,74HCT138,1 OF 8	SN74HCT138N	TEXAS INSTRUMENTS
U8	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U9	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U10	54-334	3	IC,D/A,12 BIT	DAC 1208 LCD	NATIONAL
U11	54-132		IC,OP AMP,TL074CN3,QUAD	TL074CN3	TEXAS INSTRUMENTS
U12	54-24	6	IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX

Table 5-34. A29 Rear Panel Interface PCB (6700-D-31729-3; Rev. H) Parts List (Page 6 of 6)

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
U13	54-334		IC,D/A,12 BIT	DAC 1208 LCD	NATIONAL
U14	50-9	1	IC,OP AMP,LF356,SINGLE	LF356N	NSC
U15	54-334		IC,D/A,12 BIT	DAC 1208 LCD	NATIONAL
U16	54-53	1	IC,OP AMP,TLO72,DUAL	TL072CP3	TEXAS INSTRUMENTS
U17	54-510	1	IC,CMOS,74HC04,HEX	SN74HC04N	TEXAS INSTRUMENTS
U18	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U19	54-144	5	IC,TTL,75451,DUAL,PERIPHERAL D	SN75451BP	TEXAS INSTRUMENTS
U20	54-144		IC,TTL,75451,DUAL,PERIPHERAL D	SN75451BP	TEXAS INSTRUMENTS
U21	54-144		IC,TTL,75451,DUAL,PERIPHERAL D	SN75451BP	TEXAS INSTRUMENTS
U22			NOT ASSIGNED		
U23	54-144		IC,TTL,75451,DUAL,PERIPHERAL D	SN75451BP	TEXAS INSTRUMENTS
U24	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U25	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U26	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U27	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U28			NOT ASSIGNED		
U29	20-46	5	TRANSISTOR,NPN,5 HIGH CURRENT	CA3183E	RCA
U30	20-46		TRANSISTOR,NPN,5 HIGH CURRENT	CA3183E	RCA
U31			NOT ASSIGNED		
U32			NOT ASSIGNED		
U33	20-46		TRANSISTOR,NPN,5 HIGH CURRENT	CA3183E	RCA
U34			NOT ASSIGNED		
U35			NOT ASSIGNED		
U36	50-33	7	IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U37	50-33		IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U38	50-33		IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U39	54-503	1	IC,OP-AMP,LT1007,SINGLE	LT1007CN8	LINEAR TECHNOLOGY
U40	20-46		TRANSISTOR,NPN,5 HIGH CURRENT	CA3183E	RCA
U41	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
U42	50-33		IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U43	50-33		IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U44	50-33		IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U45	50-33		IC,OP AMP,LT1056,SINGLE	LT1056CN8	LINEAR TECHNOLOGY
U46	20-46		TRANSISTOR,NPN,5 HIGH CURRENT	CA3183E	RCA
U47	54-523		IC,CMOS,74HC374,OCTAL 3-STATE	SN74HC374N	TEXAS INSTRUMENTS
U48	54-24		IC,ANALOG SWITCH,DG201,QUAD	DG201ACJ	SILICONIX
VR1	54-184	1	IC,VOLTAGE REGULATOR,7905,-5V	UA7905UC	FSC
W1	800-140	1	WIRE,JUMPER,0.400X0.125	J0.400 X 0.125 T22	SQUIRES

Table 5-35. 67XXA Rack Mount Kit With Slides

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
-	790-106	2	Hardware, Extension Bracket		Wiltron Co.
-	790-292	2	Slide Kit, Rack		Wiltron Co.
-	900-89	6	Screw, Flat Head, 8-32, 0.375, Philips		Wiltron Co.
-	900-95	8	Screw, Flat Head, 10-32, 0.250, Philips		Wiltron Co.
-	A31689	2	Trim Strip, Option Handle		Wiltron Co.
-	C31667	2	Option Handle, Mach		Wiltron Co.
-	D31678-1	1	Left Adapter Plate, Rack Mount		Wiltron Co.
-	D31678-2	1	Right Adapter Plate, Rack Mount		Wiltron Co.

Table 5-36. 67XXA Option 2A – 110 dB Step Attenuator

Option 2A is available only for the following models:
6709A/6709A-40, 6717A/6717A-20, 6719A, 6721A/6721A-20, 6728A/6728A-40

The following attenuators have been installed in 67XXAs shipped prior to Summer 1988; contact Wiltron Customer Service at (408) 778-2000 for specific information on a particular model (relative to its serial number).

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
-	4422K	1	110 dB, DC-20 GHz		Wiltron Co.
-	1010-39	1	110 dB, DC-18 GHz		Wiltron Co.

Table 5-37. 67XXA Option 2B – 90 dB Step Attenuator

Option 2B is available for all models having an upper frequency limit above 18 GHz.

The following attenuators have been installed in 67XXAs shipped prior to Summer 1988; contact Wiltron Customer Service at (408) 778-2000 for specific information on a particular model (relative to its serial number).

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
-	4522K	1	110 dB, DC-26.5 GHz		Wiltron Co.
-	1010-37	1	90 dB, DC-26.5 GHz		Wiltron Co.

Table 5-38. 67XXA Option 2C – 110 dB Step Attenuator

Option 2C is available for all models having an upper frequency limit above 18 GHz.

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
-	4622K	1	110 dB, DC-40 GHz		Wiltron Co.

Table 5-39. 67XXA Option 9K – Rear Panel K Connector (6700-D-31862)

Each synthesizer comes supplied with a rear panel K Connector™ RF Output instead of the type of connector that would normally be installed on the front panel. The front panel connector is deleted.

REF DES	WILTRON PART NO.	QTY	DESCRIPTION	VENDOR PART NO.	VENDOR NAME
-	513-31	1	Connector, RF Bulkhead, K		Wiltron Co.
-	680-645	1	Label, Rear Panel		Wiltron Co.
-	720-1/8	2	Cable Fastener, Clamp, 0.12, Wht		Wiltron Co.
-	900-148	4	Screw, Pan Hd, 4-40, 0.375, Philips		Wiltron Co.
-	900-348	4	Washer, #6, Flt, SST, 0.375		Wiltron Co.
-	900-392	4	Washer, #6, Split Lk, SST		Wiltron Co.
-	900-81	2	Screw, Flt Hd, 6-32, 0.500, Philips		Wiltron Co.
-	A13393	1	Plug Button, Painted, 0.625 Inch		Wiltron Co.
-	A31506	1	Spacer Plate, Coupler, 26.5 GHz		Wiltron Co.
-	A31886	2	Bracket, Cable Support		Wiltron Co.
-	A31887	1	Plug, RF Output, 67XXA		Wiltron Co.
-	A9201-157	1	Cable Assy, UT-141, SM-SM, 3 In		Wiltron Co.
-	A9201-158	1	Cable Assy, SMA M-M, UT-141		Wiltron Co.
-	A9201-170	1	Cable Assy, UT-141, SM-SM, Atten		Wiltron Co.

INDEX NO.	NAME	WILTRON PART NO.	QTY
1	ON/STANDBY Pushbutton	C8187-1	1
2	DECR Pushbutton	B32154-20	1
3	INCR Pushbutton	B32154-19	1
4	INCR/DECR Knob	A12070	1
5	"." Pushbutton	B32154-7	1
6	"1" Pushbutton	B32154-8	1
7	"2" Pushbutton	B32154-9	1
8	"3" Pushbutton	B32154-10	1
9	"4" Pushbutton	B32154-11	1
10	"5" Pushbutton	B32154-12	1
11	"6" Pushbutton	B32154-13	1
12	"7" Pushbutton	B32154-14	1
13	"8" Pushbutton	B32154-15	1
14	"9" Pushbutton	B32154-16	1
15	"0" Pushbutton	B32154-17	1
16	"-" Pushbutton	B32154-18	1
17	All other pushbuttons that are not otherwise called out.	C8187-1	36
18	Handle, Front	C31648	2
19	Overlay, Front Panel	D31580	1
20	Shift Key Pushbutton	C8187-4	1
21	Instrument Case	D31615-2	1
22	Foot, Rear	D13656	4
23	Handle, End Cap	B31636	4
24	Foot, Bottom	D13655	4
25	Handle Strap, Plastic	B31651	2
26	Insert, Handle Strap	B31634	2

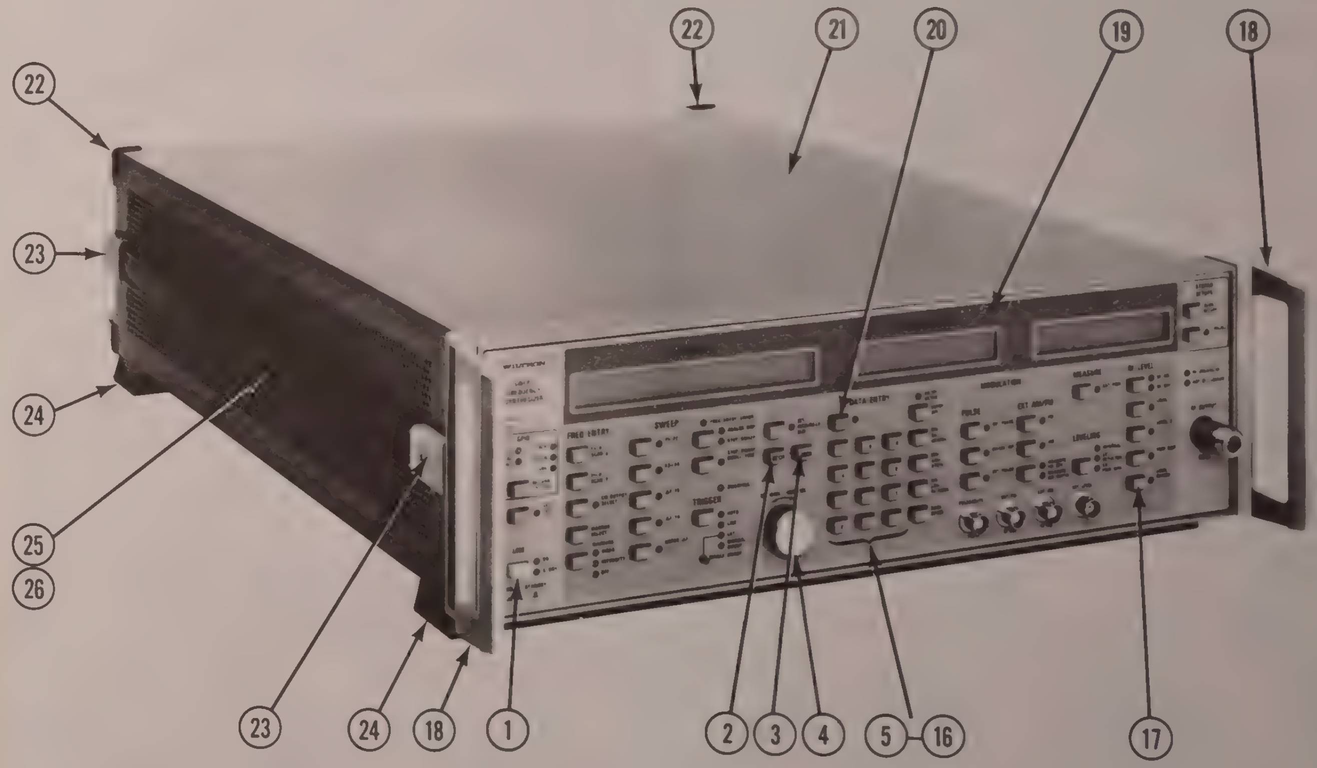
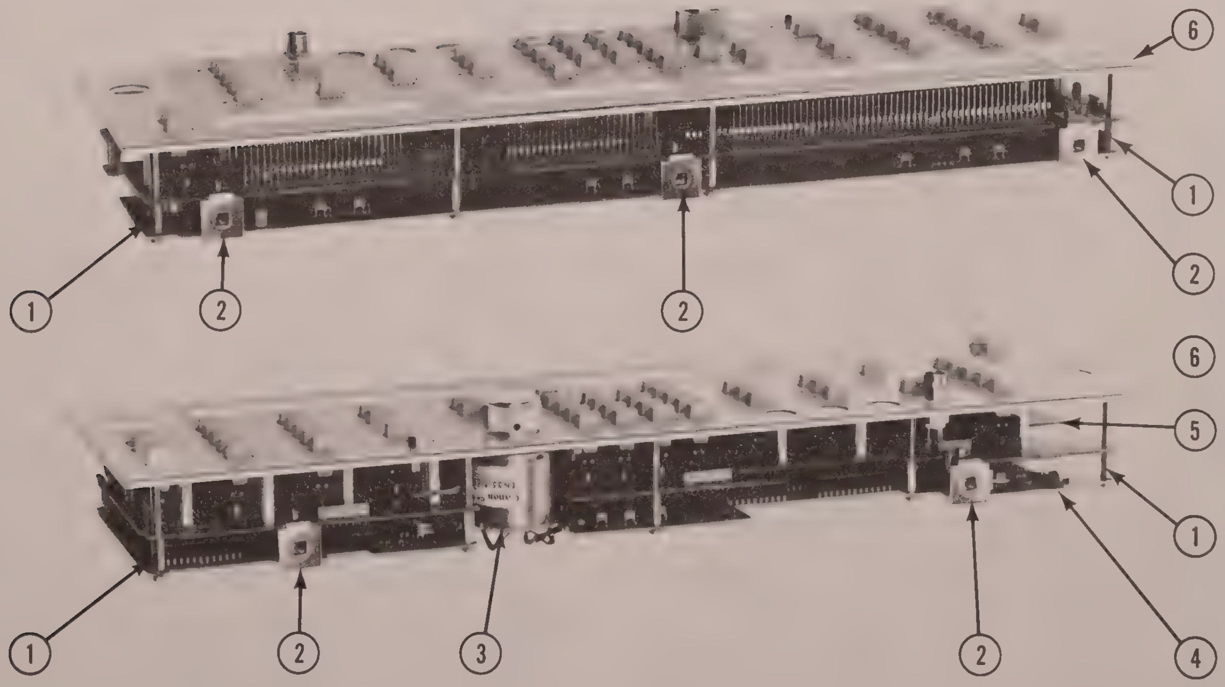
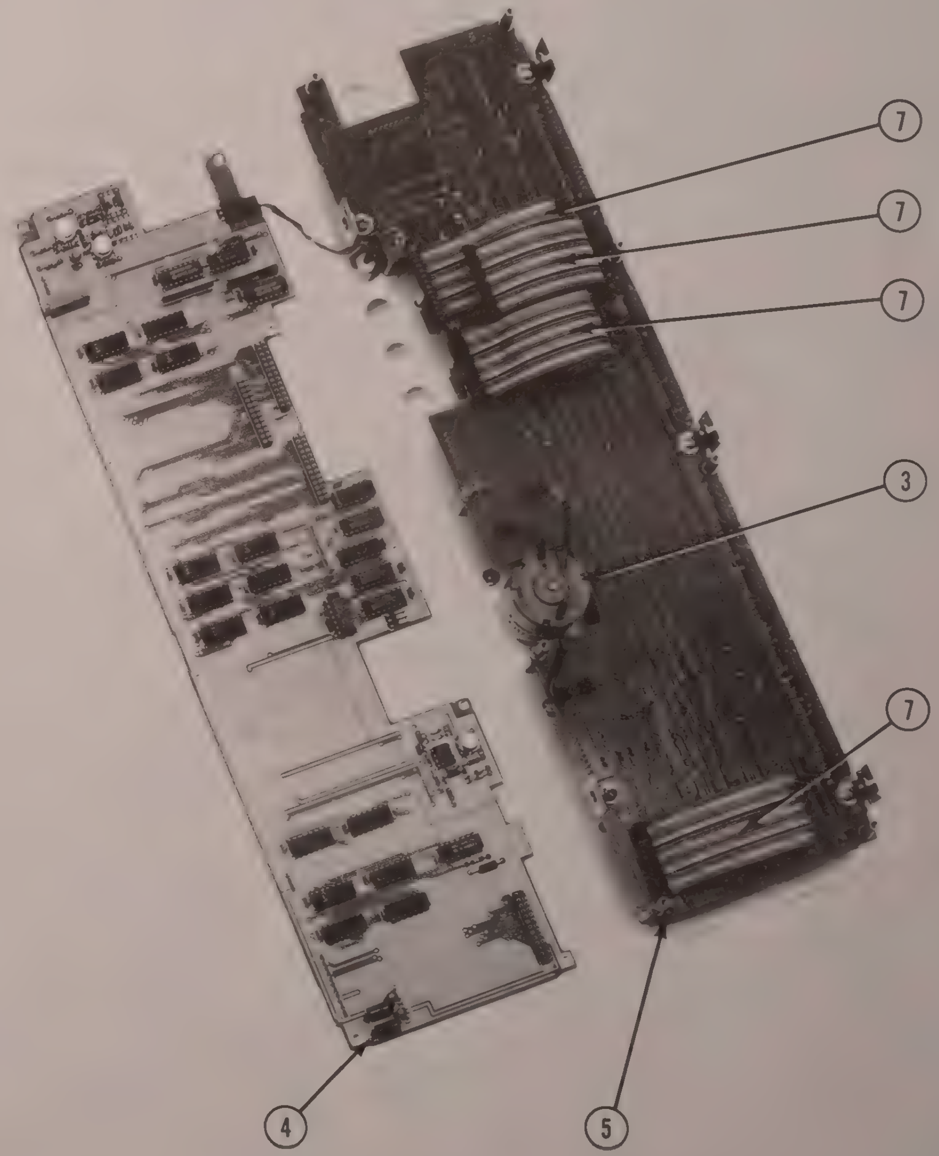


Figure 5-1. Top Assembly

INDEX NO	NAME	WILTRON PART NO.	QTY
1	Standoff, Male/Female	790-265	9
2	Mounting Bracket	A31594	5
3	DC Motor	60-25	1
4	A2 PCB, Front Panel Control	D31702-3	1
5	A1 PCB, Front Panel	D31701-3	1
6	Subpanel Plate Assembly	C31949	1
7	Ribbon Cable	803-30	4

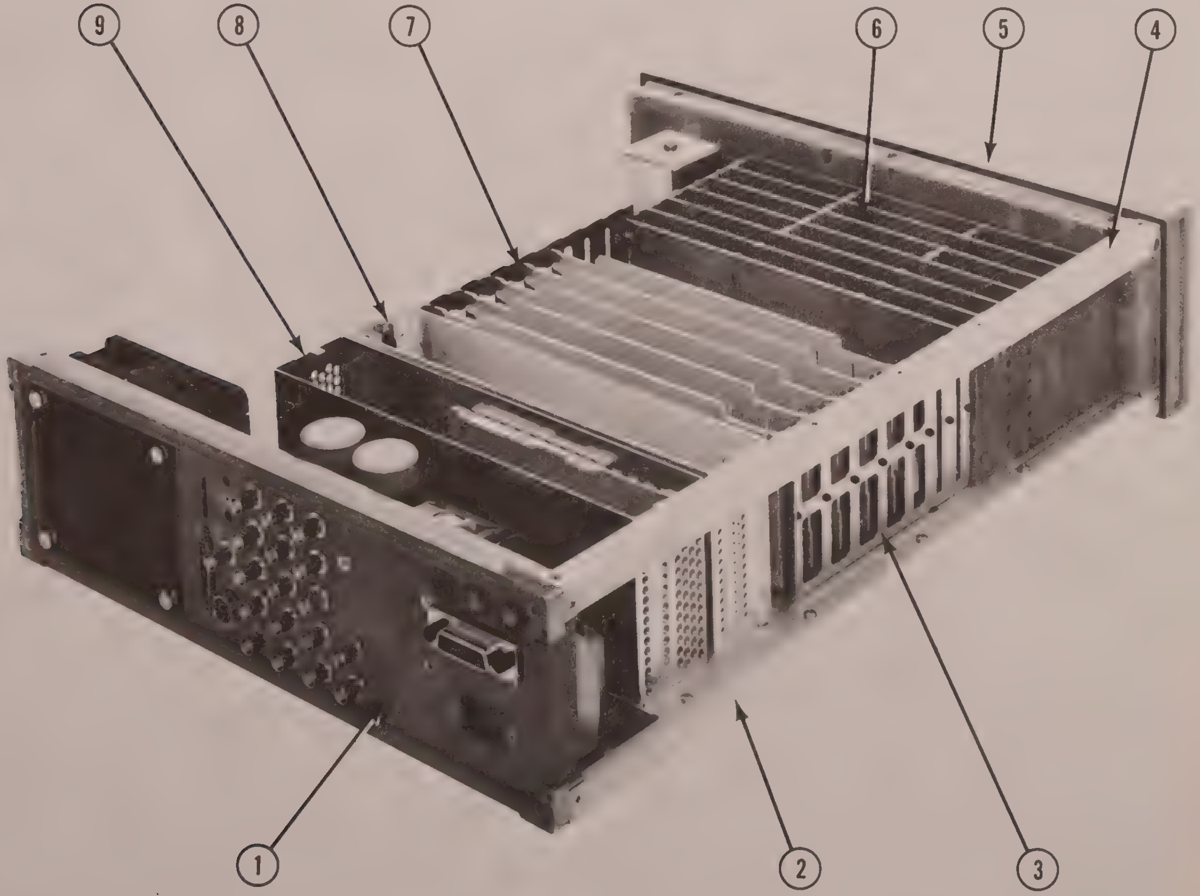




Continued

Figure 5-2. Front Panel Assembly

INDEX NO	NAME	WILTRON PART NO.	QTY.
1	Rear Casting	D31610	1
2	Extrusion, Lower Left	B31600	1
3	Card Cage Bracket, Left	C31838	1
4	Extrusion, Upper Left	B31598	1
5	Front Casting	D31938	1
6	RF Housing	D31512	1
7	Card Cage Bracket, Right	C31837	1
8	Digital Housing	C31836	1
-	Digital Housing Cover	C31547	1
9	Power Supply Housing	C31835	1
-	Power Supply Housing Cover	C31633	1
10	10 MHz Crystal Oscillator Assembly	C31924	1
11	Chassis Mount	B31641	1
12	6700 Chassis	D31549	1
13	Pillow Block Assembly	A31834	1



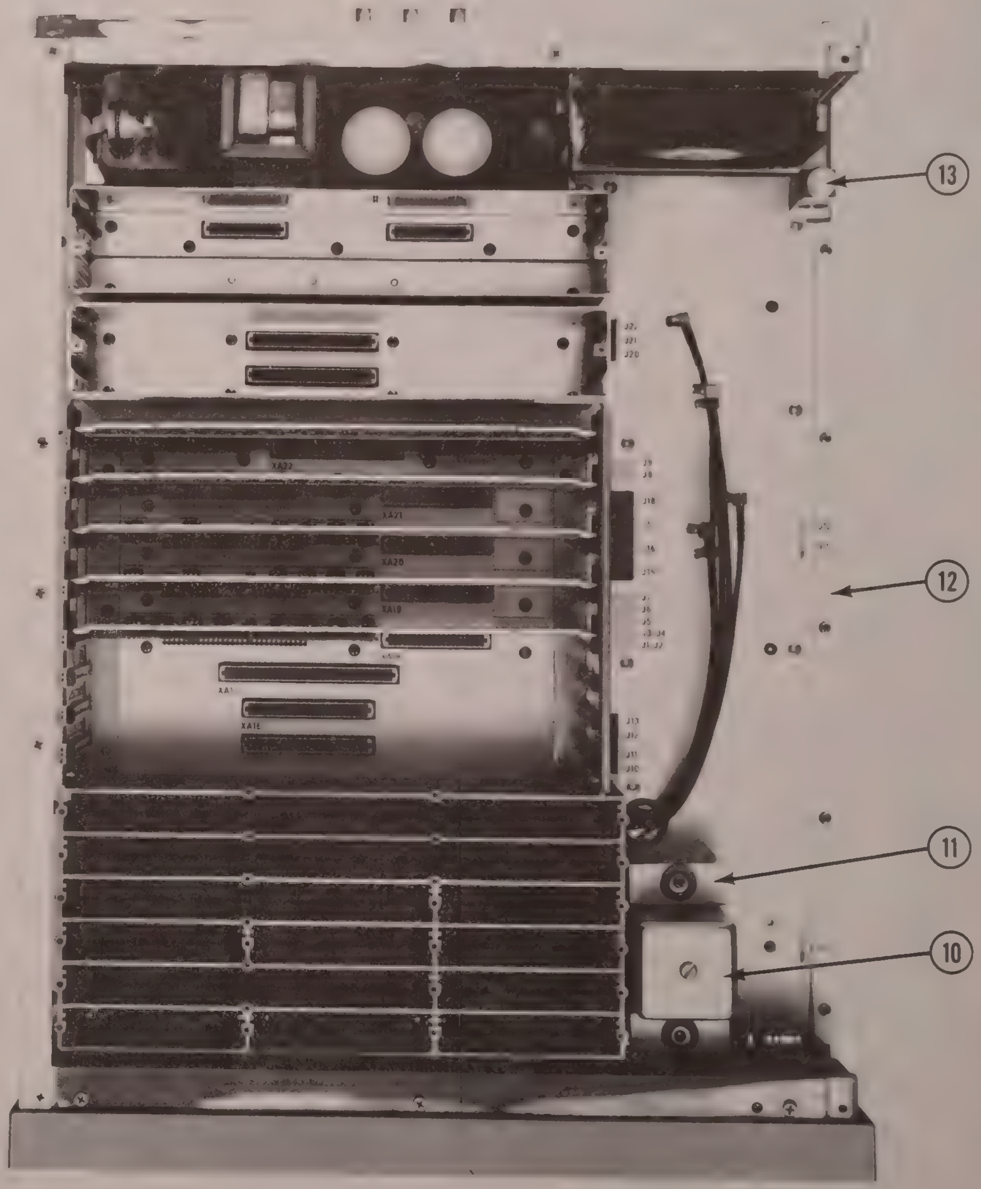
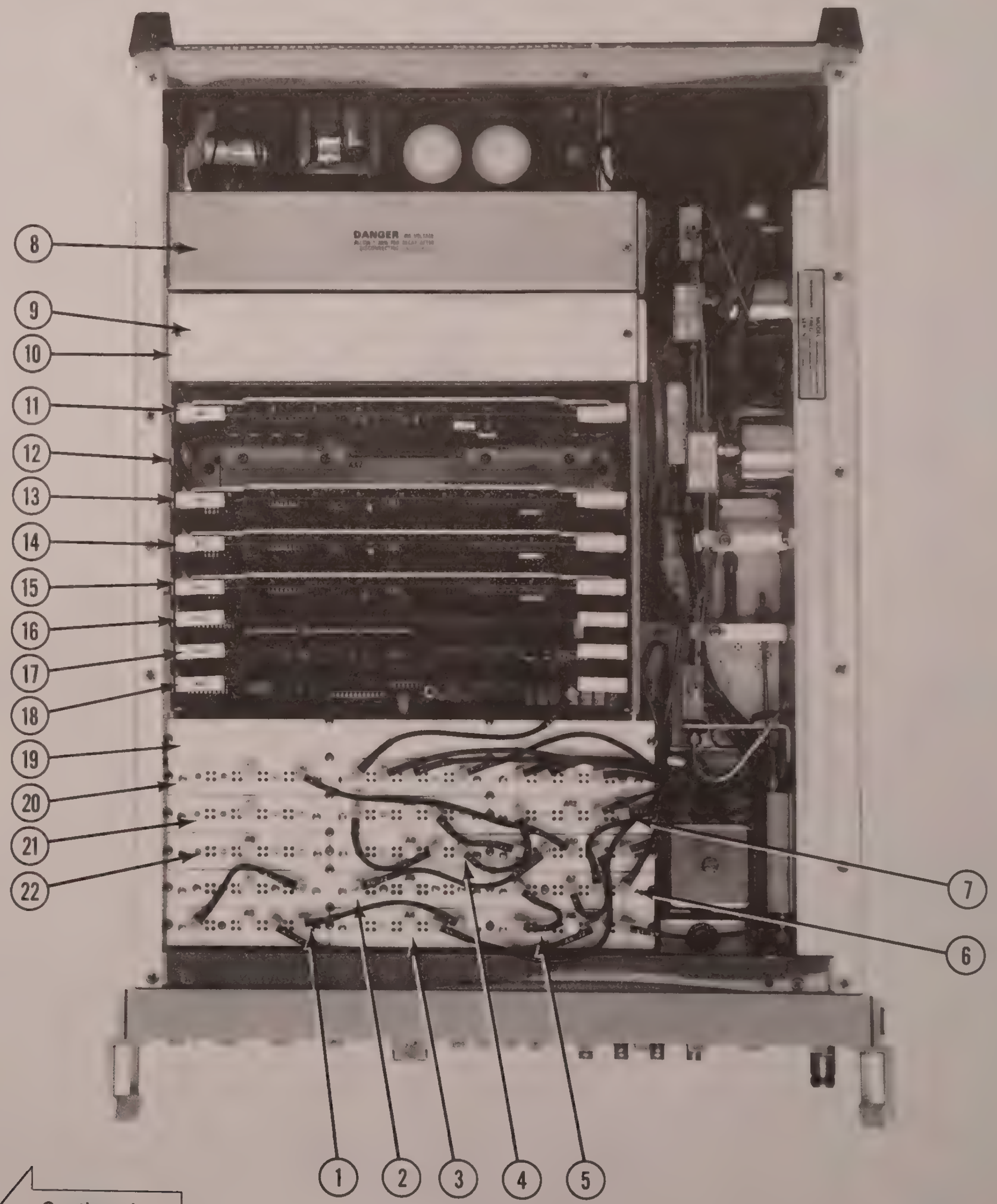


Figure 5-3. Basic Frame Assembly

INDEX NO.	NAME	WILTRON PART NO.	QTY.
1	A3 PCB, Coarse Loop Mixer	D31703-3	1
2	A6 PCB, Coarse Loop Divider	D31706-3	1
3	A4 PCB, Coarse Loop Oscillator	D31704-3	1
4	A9 PCB, Fine Loop Oscillator	D31709-3	1
5	A5 PCB, 500 MHz Reference Oscillator	D31705-3	1
6	A7 PCB, Reference Divider	D31707-3	1
7	A12 PCB, YIG Phase Detector	D31712-3	1
8	A25 PCB, Power Supply	D31725-3	1
9	A24 PCB, GPIB	D31724-3	1
10	A23 PCB, Microprocessor	D31724-3	1
11	A22 PCB, Regulator	D31722-3	1
12	A21 PCB, YIG Driver, 18-26.5 GHz	D31718-7	1
13	A20 PCB, YIG Driver, 13.25-20 GHz	D31718-6	1
14	A19 PCB, YIG Driver, 8-12.4 GHz	D31718-5	1
15	A18 PCB, YIG Driver, 2-8.4 GHz	D31718-4	1
16	A17 PCB, Analog Instruction	D31717-3	1
17	A16 PCB, FM Amplifier	D31716-3	1
18	A15 PCB, ALC	D31714-3	1
19	Cover Plate, A14, Blank	B31585	1
20	A13 PCB, Pulse Generator	D31713-3	1
21	A11 PCB, Fine Loop Divider	D31711-3	1
22	A8 PCB, Serial I/O	D31708-3	1



Continued

Figure 5-4. PCB Mechanical Assembly

NOTE: The A3 thru A13 PCBs are pull out assemblies with permanently attached cover plates and handles, as shown below. These PCBs all reside in the RF Housing.

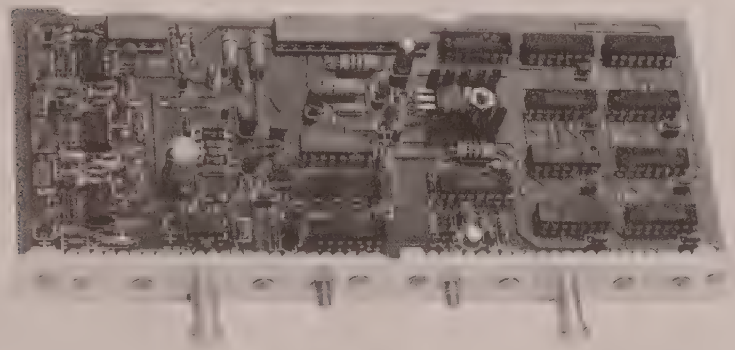


Figure 5-5. Pull Out PCBs

INDEX NO.	NAME	WILTRON PART NO.	QTY.
1	Cable Assy, SMC, F/F, RG174U, Double Shielded	A30651	17
-	A3J1 to A6J1	A30651-1	
-	A3J2 to A5J2	A30651-2	
-	A3J3 to A4J2	A30651-3	
-	A4J1 to Power Amp IN	A30651-4	
-	A5J1 to A7J1	A30651-5	
-	A6J2 to A10J2	A30651-7	
-	A7J3 to A10J4	A30651-8	
-	A7J5 to Crystal Oscillator	A30651-10	
-	A9J1 to A11J1	A30651-11	
-	A9J2 to A12J1	A30651-12	
-	A10J1 to A11J2	A30651-13	
-	A10J3 to A13J1	A30651-14	
-	A12J4 to Sample I/F OUT	A30651-17	
-	A13J6 to 2-8 Pulse Mod	A30651-22	
-	A13J7 to 8-12 Pulse Mod	A30651-23	
-	A13J8 to 12-20 Pulse Mod	A30651-24	
-	A13J9 to 20-26 Pulse Mod	A30651-25	
2	Cable Assy, BNC to SMC, RF174U, Double Shielded	A32067	6
-	Rear Panel 10 MHz IN to A7J4	A32067-1	
-	Rear Panel Pulse SYNC to A13J5	A32067-2	
-	Rear Panel 10 MHz OUT to A10J5	A32067-3	
-	Rear Panel Pulse IN to A13J4	A32067-4	
-	Rear Panel HIGH RES IN to A12J3	A32067-5	
-	Front Panel Pulse IN to A13J3	A32067-6	
3	Cable Assembly, SMA to SMC, RG174, A5J3 to Down Converter IN	A32078-1	1
4	Cable Assy, SMC-F to SMB-F, Double Shielded Coax, A13J2 to A15J1	A32079-1	1

Figure 5-6. Cabling to Digital Housing (1 of 2)

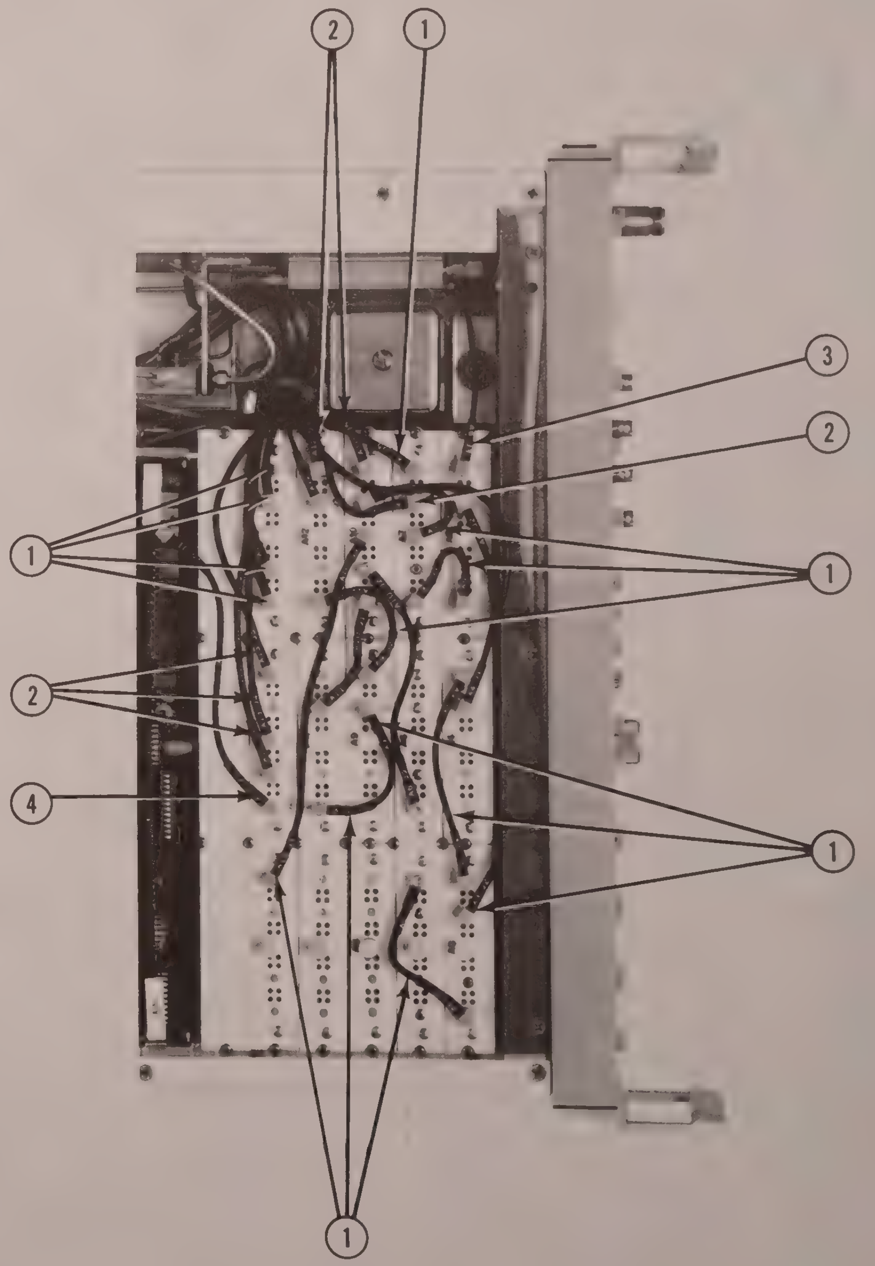
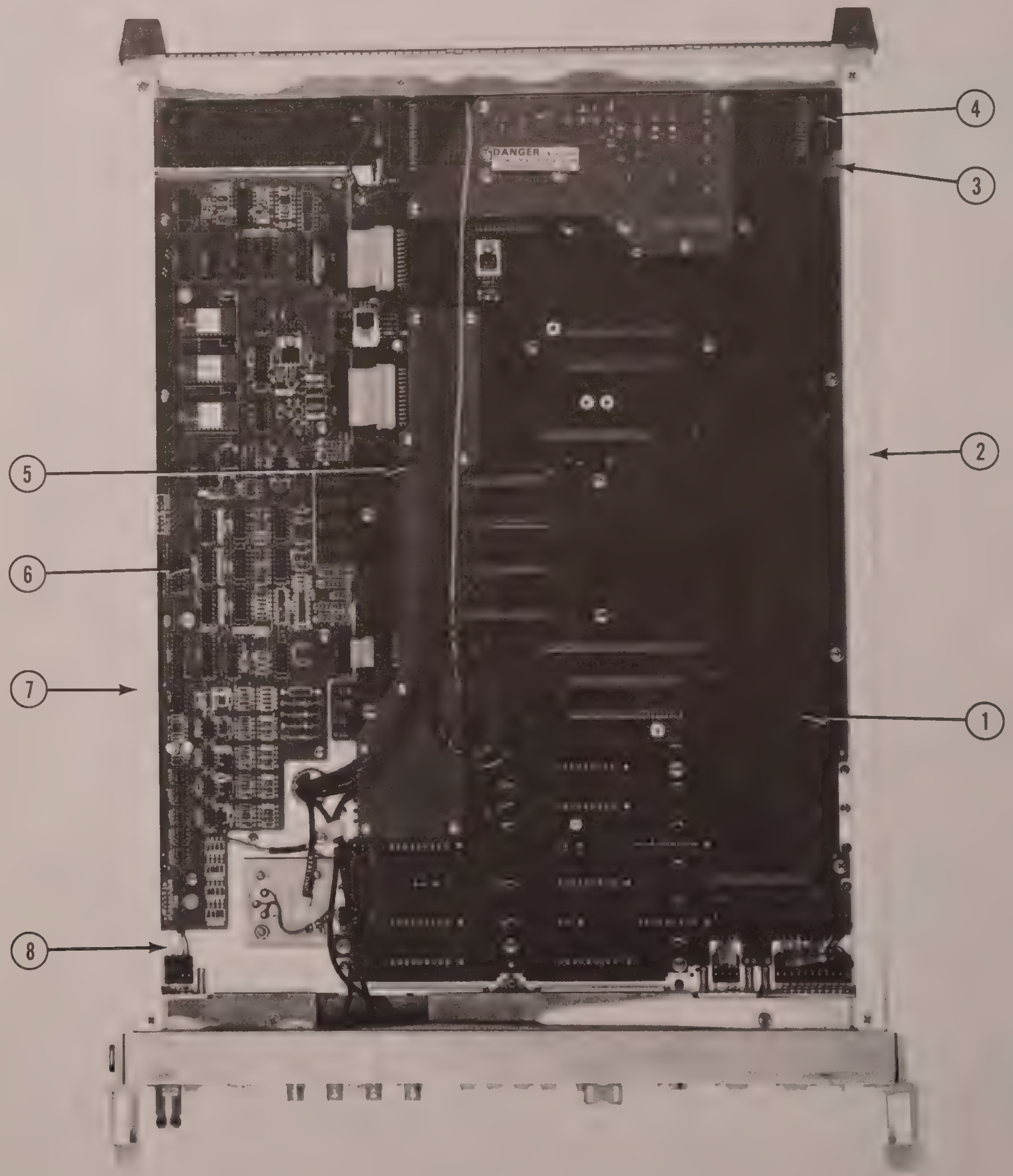


Figure 5-6. Cabling to Digital Housing (2 of 2)

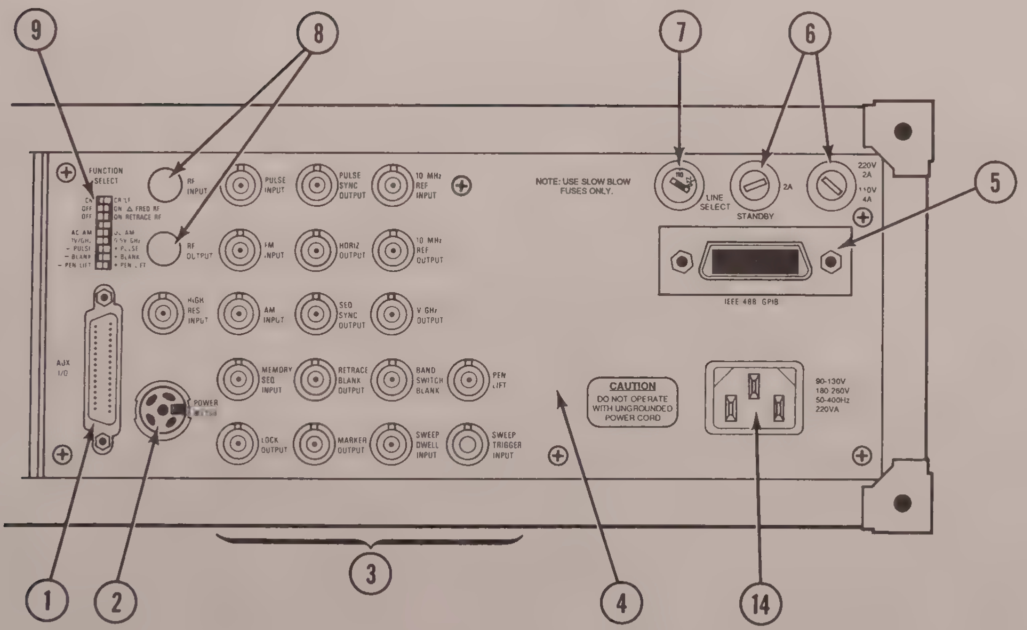
INDEX NO.	NAME	WILTRON PART NO.	QTY.
1	A28 PCB, Motherboard	D31728-3	1
2	Extrusion, Lower Left	B31600	1
3	Shield, High Voltage	B31585	1
4	Label, Danger Line Voltage	A8138	2
5	Shield, Cable	B31646	1
6	A29 PCB, Rear Panel Interface	D31729-3	1
7	Extrusion, Lower Right	B31601	1
8	Cable Assembly, 2-Conductor, 26 AWG	A32075-1	1

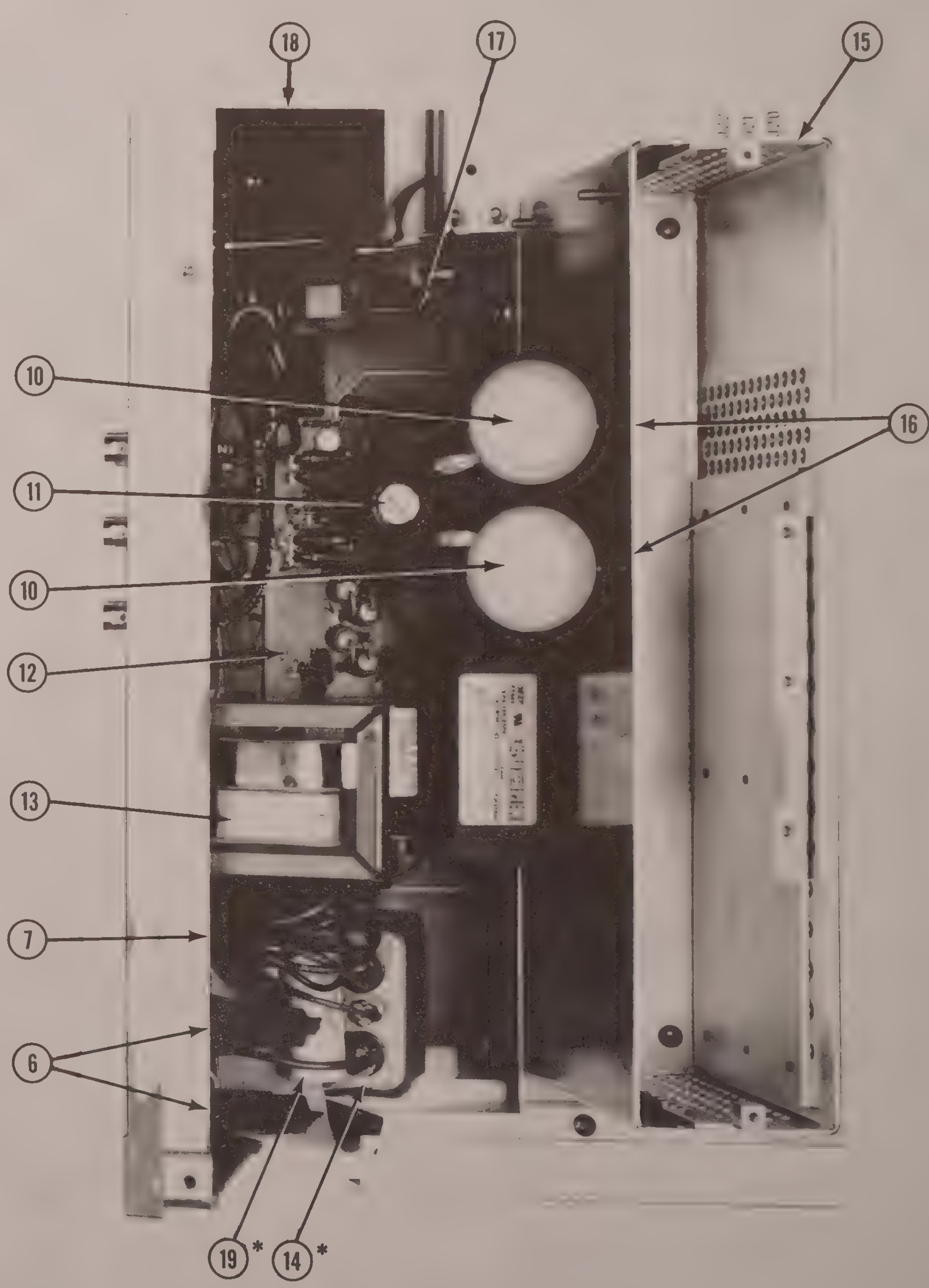


Continued

Figure 5-7. Basic Frame Assembly, Bottom View

INDEX NO.	NAME	WILTRON PART NO.	QTY.
1	Connector, AUX I/O	551-579	1
2	Cable Assembly, Power Meter	B31926	1
3	Connector, BNC Female	510-5	18
4	Overlay, Rear Panel	C31612	1
5	Cable Assembly, GPIB	A31928	1
6	Fuse Holder, 3 AG	553-176	2
7	Switch, Rotary, Line Select	410-85	1
8	Plugs, Button, 5/8	790-42	2
9	Switch, Function Select	430-229	1
10	Power Supply Regulator Capacitor	250-86	2
11	Capacitor, P/O A28 PCB	250-144	1
12	A28 PCB, Motherboard	D31728-3	1
13	Line Transformer	B31929	1
14	AC Line Connector/EMI Filter	260-11	1
15	Power Supply Housing	C31835	1
16	Mounting Clips	553-233	2
17	A27 PCB, AUX I/O	D31727-3	1
18	Subassembly, Fan	B31927	1
19	Capacitor, Fixed *	250-149	1


9
8
7
6
5
FUNCTION SELECT
ON CR LF
OFF ON △ FREQ RF
OFF ON RETRACE RF
AC AM DC AM
1V/GHz 0.5V GHz
− PULSE + PULSE
− BLANK + BLANK
− PEN LIFT + PEN LIFT
RF INPUT
RF OUTPUT
PULSE INPUT
PULSE SYNC OUTPUT
10 MHz REF INPUT
FM INPUT
HORIZ OUTPUT
10 MHz REF OUTPUT
HIGH RES INPUT
AM INPUT
SEQ SYNC OUTPUT
V GHz OUTPUT
MEMORY SEQ INPUT
RETRACE BLANK OUTPUT
BAND SWITCH BLANK
PEN LIFT
LOCK OUTPUT
MARKER OUTPUT
SWEEP DWELL INPUT
SWEEP TRIGGER INPUT
AUX I/O
POWER METER
NOTE: USE SLOW BLOW FUSES ONLY.
LINE SELECT
2A
STANDBY
220V 2A
110V 4A
IEEE 488 GPIB
CAUTION
DO NOT OPERATE WITH UNGROUNDED POWER CORD
90-130V
180-260V
50-400Hz
220VA
1
2
3
4
14

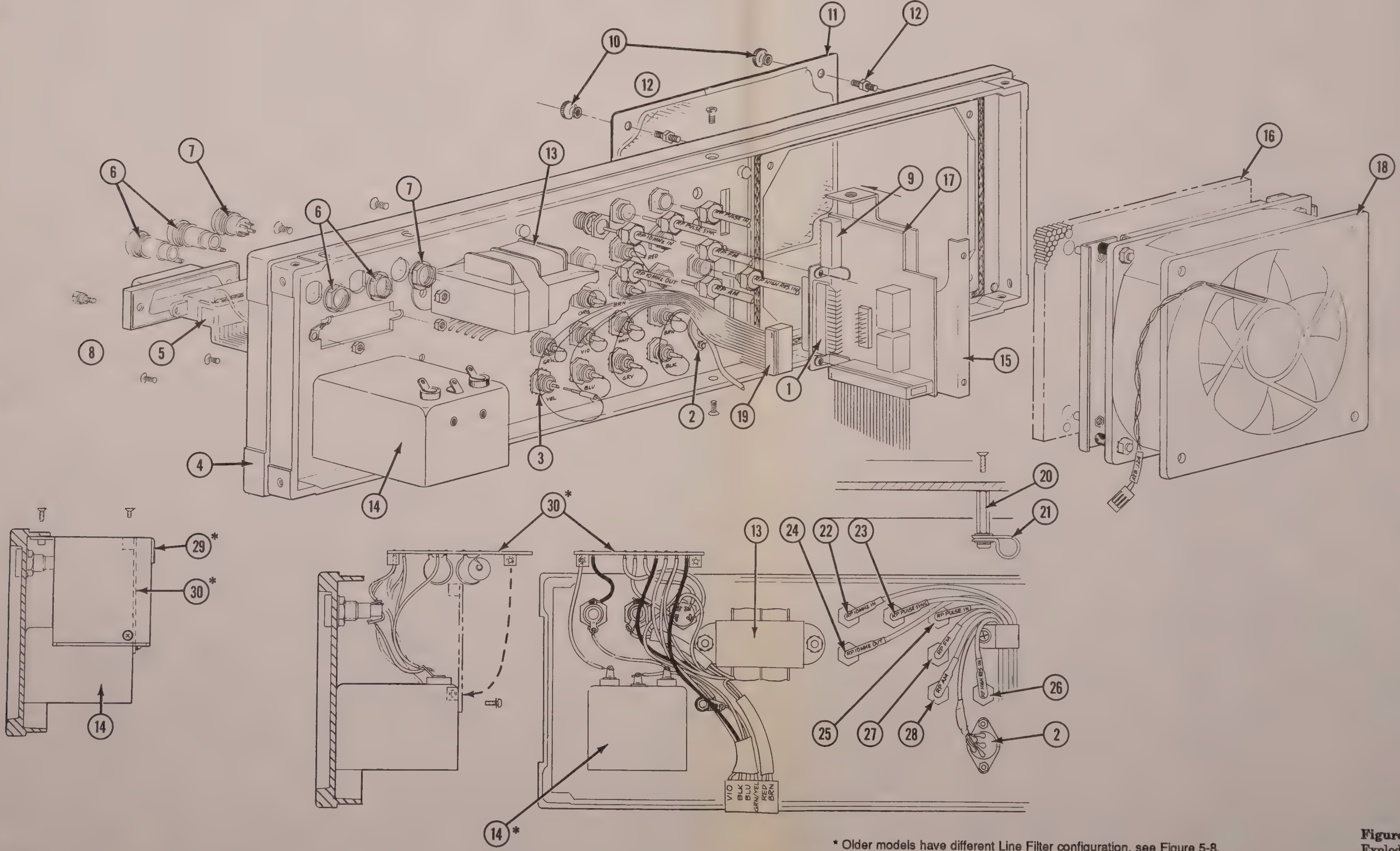

18
17
15
10
11
10
16
12
13
7
6
19 *
14 *

* Newer models have different Line Filter configuration than that shown (see Figure 5-9).

Figure 5-8. Rear Panel Assembly

INDEX NO.	NAME	WILTRON PART NO.	QTY.
1	Connector, AUX IO	551-579	1
2	Cable Assembly, Power Meter	B31926	1
3	Connector , BNC, Female	510-5	11
4	Rear Casting	D31610	1
5	Cable Assembly, GPIB	A31928	1
6	Fuse Holder, 3 AG	553-176	2
7	Switch, Rotary	410-85	1
8	Connector Accessory, Mounting Hardware	551-588	1
9	Switch, Function Select	430-299	1
10	Nut, Thumb, 6/32	790-193	4
11	Filter, Fan	783-403	1
12	Standoff, M/F, 6/32	785-882	4
13	Line Transformer	B31929	1
14	AC Line Connector/EMI Filter,	260-11	1
15	Bracket, Chassis Support	B31597	1
16	Honeycomb, Fan	B31591	1
17	PC Assembly, AUX I/O, A27	C31727-3	1
18	Sub-Assembly, Fan	B31927	1
19	Cable Assembly, Ribbon, 14 Conductor	A31931	1
20	Standoff, plain, 6/32	785-610	1
21	Cable Fastener,Clamp	720-3/8	1
22	Cable Assembly, BNC to SMC	A32067-1	1
23	Cable Assembly, BNC to SMC	A32067-2	1
24	Cable Assembly, BNC to SMC	A32067-3	1
25	Cable Assembly, BNC to SMC	A32067-4	1
26	Cable Assembly, BNC to SMC	A32067-5	1
27	Cable Assembly, BNC to 3 Pin	A32068-1	1
28	Cable Assembly, BNC to 3 Pin	A32068-2	1
29	Assembly, Support, Line Filter (or Cap) *	B31970	1
30	PC Assembly, Line Filter, A26 *	D31726	1

Figure 5-9. Rear Panel Assembly, Exploded View (1 of 2)


11
12
10
12
16
18
7
6
13
7
6
9
17
RP PULSE IN
RP PULSE SYNC
RP 10MHz IN
RED
RP FM
RP 10MHz OUT
RP HIGH RES IN
RP AM
BRN
ORG
GRN
VIO
WHT
BLK
GRY
YEL
BLU
15
8
5
1
2
19
3
4
14
20
21
30*
29*
30*
13
24
22
23
RP 10MHz IN
RP PULSE SYNC
RP PULSE IN
RP 10MHz OUT
RP FM
RP AM
RP HIGH RES IN
26
2
25
27
28
14
VIO
BLK
BLU
GRN/YEL
RED
BRN
14*

* Older models have different Line Filter configuration, see Figure 5-8.

Figure 5-9. Rear Panel, Exploded View (Sheet 2 of 2)

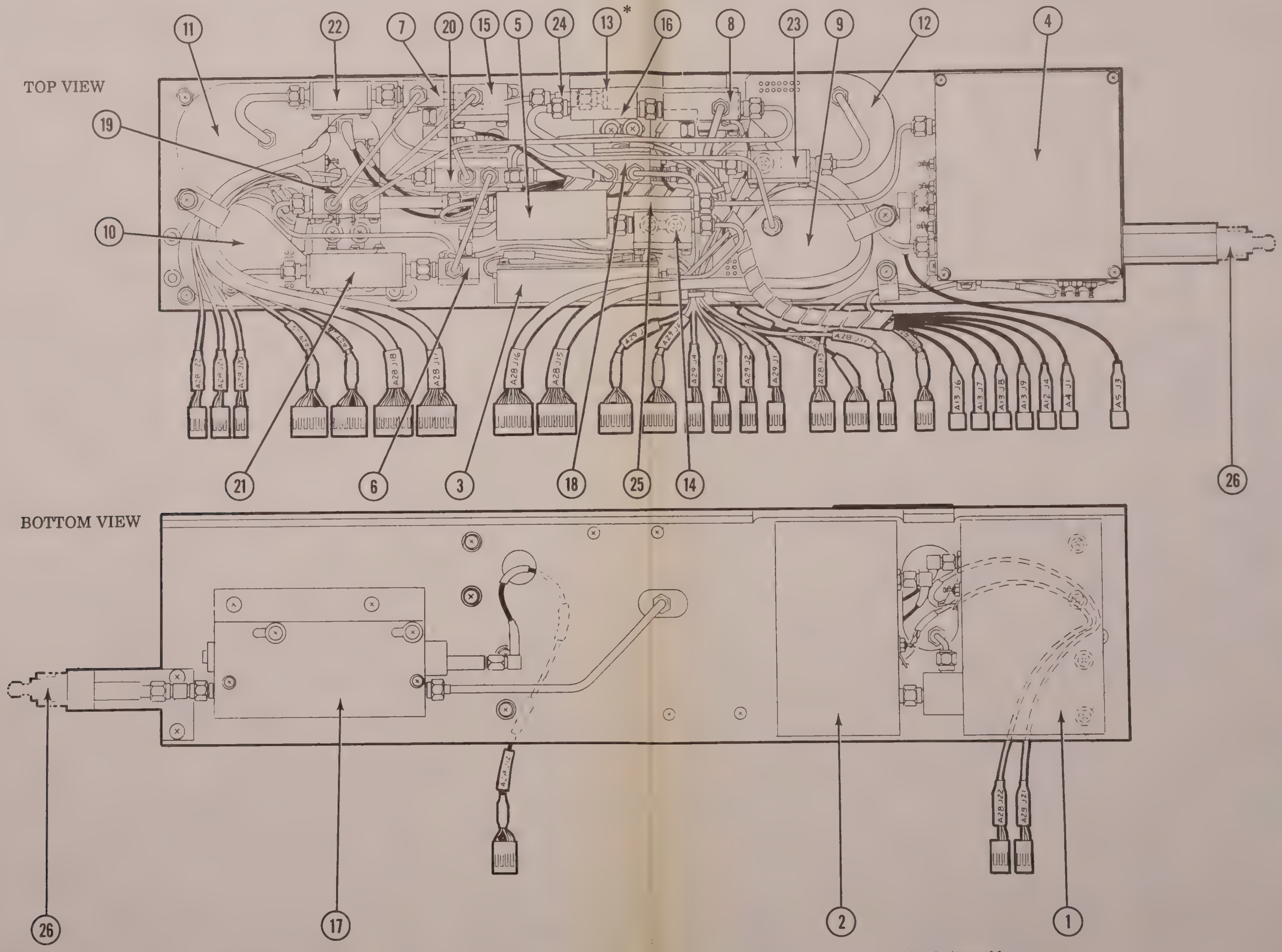

TOP VIEW
11
22
7
20
15
5
24
13*
16
8
23
9
12
4
19
10
21
6
3
18
25
14
26
A13 J6
A13 J7
A13 J8
A13 J9
A12 J4
A4 J1
A5 J3
BOTTOM VIEW
26
17
2
1

Figure 5-10. Microwave Deck Assembly, Top and Bottom View

* Item 13 (Frequency Doubler/Amplifier) is located behind Items 8 and 16.

Table 5-40. Microwave Deck Parts List (1 of 3)

INDEX NO.	WILTRON PART NO.	QTY	DESCRIPTION
			MICROWAVE DECK ELECTRICAL COMPONENTS
1	C31921	1	A30 SAMPLER/IF AMPLIFIER ASSY
2	B31867	1	A31 POWER AMPLIFIER ASSY, CABLED
3	C31755-3	1	SWITCHED FILTER INTERFACE PC ASSY
4	A31959	1	LOW POWER DOWN CONVERTER ASSY, or
	A31968	*	HIGH POWER DOWN CONVERTER ASSY
5	A31960	1	CONTROL MODULATOR ASSY, 2-8 GHz, CABLED
6	A31961	1	CONTROL MODULATOR ASSY, 8-12.4 GHz, CABLED
7	A31962	1	CONTROL MODULATOR ASSY, 12.4-20 GHz, CABLED
8	A31963	1	CONTROL MODULATOR ASSY, 18-26.5 GHz, CABLED
9	C31900-2	1	OSCILLATOR ASSY, 2-8 GHz, HIGH POWER
10	C31901-1	1	OSCILLATOR ASSY, 8-12.4 GHz, or
	C31901-2	*	OSCILLATOR ASSY, 8-12.4 GHz, HIGH POWER
11	C31902-1	1	OSCILLATOR ASSY, 12.4-20 GHz, or
	C31902-2	*	OSCILLATOR ASSY, 12.4-20 GHz, HIGH POWER
12	C31903-1	1	OSCILLATOR ASSY, 18-26.5 GHz, or
	C31903-2	*	OSCILLATOR ASSY, 18-26.5 GHz, HIGH POWER
13	60-49	1	FREQUENCY DOUBLER/AMPLIFIER ASSY
14	B17432	1	RF AMPLIFIER, 2-8 GHz
	B18765	*	RF AMPLIFIER, 8-12.4 GHz
15	B18730	1	RF AMPLIFIER, 12.4-20 GHz
16	C18860	1	RF AMPLIFIER, 18-26.5 GHz
17	D20165	1	DIRECTIONAL COUPLER, 0.01-40 GHz, or
	C15360	1	DIRECTIONAL COUPLER, 0.01-26.5 GHz
18	A31998	1	OUTPUT PIN SWITCH ASSY, 0.01-40 GHz, or
	A31956	1	OUTPUT PIN SWITCH ASSY, 0.01-26.5 GHz
19	A31957	1	SAMPLER PIN SWITCH ASSY
20	A31997	1	DPDT PIN SWITCH ASSY (40 GHz MODELS ONLY)
21	1000-39	1	ISOLATOR, DUAL, 8-12.4 GHz
22	1000-40	1	ISOLATOR, DUAL, 12.4-20 GHz
23	1000-41	1	ISOLATOR, 18-26.5 GHz
24	43KA-6	1	ATTENUATOR, 6 dB
25	43KA-10	1	ATTENUATOR, 10 dB
26	A31955-1	1	K CONNECTOR RF OUTPUT ASSY, or
	A31955-2	1	TYPE N RF OUTPUT CONNECTOR ASSY
	250-39A	1	CAPACITOR, FXD, TANT, 4.7 uF, 20%

* – These components are used in the 67XXA-10, -20, and -40 models.

Table 5-40. Microwave Deck Parts List (2 of 3)

REF. DES.	WILTRON PART NO.	QTY	DESCRIPTION
			MICROWAVE DECK CABLE ASSEMBLIES
	A12364	1	CABLE ASSY, THERMOSTAT, 67XXA
	A30645-1	1	CABLE ASSY, (4-PIN CONNECTOR)
	A30651-4	1	CABLE ASSY, SMC F/F, DBL-SHLD, COAX
	A30651-14	1	CABLE ASSY, SMC F/F, DBL-SHLD, COAX
	A30651-17	1	CABLE ASSY, SMC F/F, DBL-SHLD, COAX
	A30651-22	1	CABLE ASSY, SMC F/F, DBL-SHLD, COAX
	A30651-23	1	CABLE ASSY, SMC F/F, DBL-SHLD, COAX
	A30651-24	1	CABLE ASSY, SMC F/F, DBL-SHLD, COAX
	A30651-25	1	CABLE ASSY, SMC F/F, DBL-SHLD, COAX
	A31965-9	1	CABLE ASSY, 3-PIN TO BARE LEADS
	A32078-1	1	CABLE ASSY, SMA-SMC, RG-174
	A9201-147	1	ASSY, CABLE, UT141,SM-SM, 2.0IN
	A9201-148	1	ASSY, CABLE, UT141, SM-SM, 1.4IN
	A9201-149	1	ASSY, CABLE, UT141, SM-SM, 6.7IN
	A9201-151	1	ASSY, CABLE, UT141, SM-SM, 3.0IN
	A9201-152	1	ASSY, CABLE, UT141, SM-SM
	A9201-153	1	ASSY, CABLE, UT141, SM-SM
	A9201-154	1	ASSY, CABLE, UT141, SM-SM, 5.5IN
	A9201-155	1	ASSY, CABLE, UT141, SM-SM
	A9201-156	1	ASSY, CABLE, UT141, SM-SM
	A9201-173	1	ASSY, CABLE, UT141, SM-SM
	A9201-175	1	ASSY, CABLE, UT141, SM-SM
	A9201-182	1	ASSY, CABLE, UT141, SM-SM
	A9201-183	1	ASSY, CABLE, UT141, SM-SM
	A9201-185	1	ASSY, CABLE, UT141, SM-SM
	A9202-88	1	ASSY, CABLE, UT85, SM-SM, 7.0IN
	A9202-89	1	ASSY, CABLE, UT85, SM-SM
	A9202-90	1	ASSY, CABLE, UT85, SM-SM, 3.5IN
	A9202-93	1	ASSY, CABLE, UT85, SM-SM, 4.0IN
	A9202-94	1	ASSY, CABLE, UT85, SM-SM
	A9202-95	1	ASSY, CABLE, UT85, SM-SM, 2.0IN
	A9202-96	1	ASSY, CABLE, UT85, SM-SM
	A9202-97	1	ASSY, CABLE, UT85, SM-SM, 5.0IN
	A9202-98	1	ASSY, CABLE, UT85, SM-SM
	A9292-99	1	ASSY, CABLE, UT85, SM-SM, 6.0IN
	A9202-100	1	ASSY, CABLE, UT85, SM-SM, 2.0IN
	A9202-103	1	ASSY, CABLE, UT85, SM-SM, 4.5IN
	A9202-105	1	ASSY, CABLE, UT85, SM-SM
	A9202-116	1	ASSY, CABLE, UT85, SM-SM
	A9202-118	1	ASSY, CABLE, UT85, SM-SM
	A9202-120	1	ASSY, CABLE, UT85, SM-SM
	A9202-121	1	ASSY, CABLE, UT85, SM-SM
	A9202-122	1	ASSY, CABLE, UT85, SM-SM
	A9202-123	1	ASSY, CABLE, UT85, SM-SM
	A9202-124	1	ASSY, CABLE, UT85, SM-SM
	A9202-125	1	ASSY, CABLE, UT85, SM-SM
	A9202-126	1	ASSY, CABLE, UT85, SM-SM
	A9202-127	1	ASSY, CABLE, UT85, SM-SM
	A9202-130	1	ASSY, CABLE, UT85, SM-SM
	A9202-131	1	ASSY, CABLE, UT85, SM-SM
	A9202-132	1	ASSY, CABLE, UT85, SM-SM
	A9202-133	1	ASSY, CABLE, UT85, SM-SM
	A9203-42	1	ASSY, CABLE, UT85, SM-SF
	A9203-49	1	ASSY, CABLE, UT85, SM-SF
	A9204-41	1	ASSY, CABLE, UT41, SM-SF
	A9204-42	1	ASSY, CABLE, UT41, SM-SF
	A9204-48	1	ASSY, CABLE, UT41, SM-SF
	A9210-11	1	ASSY, CABLE, UT118, SM-SM

Table 5-40. Microwave Deck Parts List (3 of 3)

REF. DES.	WILTRON PART NO.	QTY	DESCRIPTION
MICROWAVE DECK MECHANICAL COMPONENTS			
	A31691	1	BRACKET, DUAL ISOLATOR (Ku BAND)
	A31692	1	BRACKET, DUAL ISOLATOR (X BAND)
	A31697	1	HEAT SINK PLATE, AMPLIFIER (K BAND)
	A31877	1	BRACKET, HEAT SINK (SC BAND)
	A31985	1	BRACKET, DUAL ISOLATOR (K BAND)
	A31986	1	BRACKET, AMPLIFIER (SC BAND)
	A31994	1	MTG BRACKET, COUPLER
	A31995	1	CARRIER PLATE, COUPLER
	A8133	1	ASSY, LABEL, RF DECK
	B31987	1	HEATSINK,DOUBLER/AMPLIFIER
	B31993	1	MOUNTING PLATE, RF OUTPUT
	B31870	1	CLAMP. FILTER
	C19130	1	VIDEO FILTER
	D19872	1	COUPLER, T
	D19874	1	COUPLER, T
	D31501	1	HEAT SINK, RF DECK (MACH), or
	D31990	1	HEAT SINK, RF DECK (MACH)
	35WR28K	1	ADAPTER ASSY, MALE WAVEGUIDE
	720-1/2	1	CABLE FASTENER, CLAMP, 0.50, WHT
	720-1/4	1	CABLE FASTENER, CLAMP, 0.25, WHT
	720-7/16	1	CABLE FASTENER, CLAMP, 0.44, WHT
	720-3/16	1	CABLE FASTENER, CLAMP, 0.19, WHT
	721-2	5	CABLE FASTENER, TIE, 0.75, WHT
	721-18	1	CABLE ACCESSORY, SPIRAL WRAP
	785-891	2	STANDOFF, PLAIN, 6-32, 1.625
	790-294	1	STANDOFF, PLAIN
	900-41	2	SCREW, FLT HD, 4-40, 0.312, PHIL
	900-45	4	SCREW, FLT HD, 4-40, 0.375, PHIL
	900-56	4	SCREW, FLT HD, 4-40, 0.750, PHIL
	900-74	2	SCREW, FLT HD, 6-32, 0.375, PHIL
	900-81	6	SCREW, FLT HD, 6-32, 0.500, PHIL
	900-124	9	SCREW, PAN HD, 2-56, 0.250, PHIL
	900-127	3	SCREW, PAN HD, 2-56, 0.375, PHIL
	900-148	18	SCREW, PAN HD, 4-40, 0.375, PHIL
	900-151	3	SCREW, PAN HD, 4-40, 0.500, PHIL
	900-161	4	SCREW, PAN HD, 4-40, 1.000, PHIL
	900-166	2	SCREW, PAN HD, 6-32, 0.250, PHIL
	900-168	20	SCREW, PAN HD, 6-32, 0.312, PHIL
	900-178	2	SCREW, PAN HD, 6-32, 0.437, PHIL
	900-332	1	NUT. KEP, 6-32, 0.312
	900-345	8	WASHER, #4, FLT, SST. *, 1, 0.312
	900-346	4	WASHER, #4, FLT SMALL, SST
	900-348	17	WASHER, #6, FLT, SST
	900-349	8	WASHER, #6, FLT SMALL, SST
	900-389	9	WASHER, #2, SPLIT LK, SST
	900-391	22	WASHER, #4, SPLIT LK, SST
	900-392	24	WASHER, #6, SPLIT LK, SST
	900-514	2	WASHER, #2 FLT, SST
	900-547	2	SCREW, PAN HD, 2-56, 0.750, PHIL

SECTION VI
SERVICE

CONTENTS

Paragraph Description Page

6A-SERVICE INTRODUCTION

6A-1 INTRODUCTION 6A-1

6A-2 GENERAL INFORMATION 6A-1
  6A-2.1 Model Frequency Coverage 6A-1
  6A-2.2 Replaceable Subassemblies and Parts 6A-2
  6A-2.3 Module Exchange Program 6A-2
  6A-2.4 Preventive Maintenance 6A-2
  6A-2.5 Recommended Test Equipment 6A-2
  6A-2.6 Schematic Conventions 6A-2
  6A-2.7 Static Handling Procedures 6A-2

6B-THEORY/BLOCK DIAGRAM

6B-1 INTRODUCTION 6B-1

6B-2 INSTRUMENT MECHANICAL LAYOUT 6B-1

6B-3 CIRCUIT SUBSYSTEMS 6B-1
  6B-3.1 Front Panel Assembly (A1 and A2 PCBs) 6B-1
  6B-3.2 Digital Control/GPIB Interface (A8, A23, and A24 PCBs) 6B-1
  6B-3.3 Inputs/Outputs (A27 PCB and part of A29 PCB) 6B-1
  6B-3.4 Frequency Synthesis Subsystem-RF Casting PCBs (A3-A7, A9-A12) 6B-1
  6B-3.5 Analog Instruction (A17 PCB) 6B-2
  6B-3.6 YIG Drivers (A18-A21 PCBs) 6B-2
  6B-3.7 ALC/Pulse Modulation (A13, A15 and p/o A29 PCBs) 6B-2
  6B-3.8 Power Supply (A22, A25, A26, & p/o A28) 6B-2
  6B-3.9 Motherboard/Interconnections (A28) 6B-2
  6B-3.10 Microwave Deck 6B-2

6B-4 FREQUENCY SYNTHESIS CIRCUITS, FUNCTIONAL DESCRIPTION 6B-2
  6B-4.1 Overall Operation 6B-2
  6B-4.2 Down Converter Band (0.01-2.0 GHz) 6B-4
  6B-4.3 Frequency Doubler Band 26.5-40.0 GHz) 6B-4
  6B-4.4 FM Modulation Circuits 6B-5
  6B-4.5 Sweep Mode Operation 6B-5

6B-5 ALC AND MODULATION CIRCUITS, FUNCTIONAL DESCRIPTION 6B-5
  6B-5.1 ALC Loop Operation 6B-5
  6B-5.2 A13 Pulse Generator PCB Operation 6B-6

SECTION VI
SERVICE

CONTENTS (Continued)

Paragraph Description Page

6C-TROUBLESHOOTING

6C-1 OVERALL TROUBLESHOOTING 6C-1

6C-2 HIDDEN-KEY ROUTINES 6C-1

6C-3 ERROR CODES 6C-1

6C-4 MASTER RESET FUNCTION 6C-1

6C-5 TROUBLESHOOTING FAULTS THAT DO NOT PRODUCE ERROR CODES 6C-1

6D-FRONT PANEL

6D-1 FRONT PANEL ASSEMBLIES: A1 and A2 PCBs 6D-1

6D-2 FRONT PANEL ASSEMBLIES, OVERALL DESCRIPTION 6D-1

6D-3 A1 FRONT PANEL PCB, GENERAL DESCRIPTION 6D-3
6D-3.1 Alpha-Numeric Displays (LCDs) and Display Digit Drivers 6D-2
6D-3.2 Indicator LEDs and Latch Drivers 6D-2
6D-3.3 Keyboard Matrix 6D-2

6D-4 A2 FRONT PANEL CONTROL PCB, GENERAL DESCRIPTION 6D-2
6D-4.1 Serial Input/Parallel Output 6D-2
6D-4.2 DECREASE/INCREASE Knob Motor 6D-3
6D-4.3 External Detector Amplifier (EXT LEVEL BNC Input) 6D-3

6D-5 A1 FRONT PANEL PCB, DETAILED CIRCUIT DESCRIPTION 6D-3
6D-5.1 Line Switch and Power on Circuits 6D-3
6D-5.2 Front Panel Keys 6D-3
6D-5.3 LED Drivers 6D-4
6D-5.4 LCD Digit Drivers 6D-4
6D-5.5 Digit Driver Strobe Signals 6D-4

6D-6 A2 FRONT PANEL CONTROL PCB, DETAILED CIRCUIT DESCRIPTION 6D-4
6D-6.1 Serial Input 6D-4
6D-6.2 Keyboard Encoding 6D-4
6D-6.3 Display Message Data Latches 6D-5
6D-6.4 Knob Amplifier 6D-5
6D-6.5 External Level Detector Preamplifier 6D-5

6D-7 FRONT PANEL ASSEMBLIES, TROUBLESHOOTING 6D-6

6D-8 FRONT PANEL ASSEMBLIES, SERVICE SHEETS 6D-6

6E-DIGITAL CONTROL

6E-1 DIGITAL CONTROL ASSEMBLIES: A23, A24, and A8 PCBs 6E-1

6E-2 DIGITAL CONTROL ASSEMBLIES, OVERALL DESCRIPTION 6E-1

6E-3 A23 MICROPROCESSOR PCB, GENERAL DESCRIPTION 6E-1

SECTION VI
SERVICE

CONTENTS (Continued)

Paragraph **Description** **Page**

6E-4 A24 GPIB PCB, GENERAL DESCRIPTION 6E-2

6E-5 A8 SERIAL I/O PCB, GENERAL DESCRIPTION 6E-3
- 6E-5.1 Transmitting Data 6E-3
- 6E-5.2 Receiving Data 6E-3
- 6E-5.3 Ground Return Mux 6E-3
- 6E-5.4 U4 Fine Loop Flip-Flop 6E-3

6E-6 A8 SERIAL I/O PCB, DETAILED CIRCUIT DESCRIPTION 6E-4
- 6E-6.1 Microprocessor Interface 6E-4
- 6E-6.2 Clock Timer 6E-4
- 6E-6.3 Shift Registers 6E-4
- 6E-6.4 Multiplexers 6E-4
- 6E-6.5 Ground Return Multiplexer 6E-5
- 6E-6.6 Serial Data Input 6E-5
- 6E-6.7 External Reference Detected Signal Input 6E-5
- 6E-6.8 Fine Loop Data (FLD12) Latch 6E-5

6E-7 DIGITAL CONTROL ASSEMBLIES, TROUBLESHOOTING 6E-5

6E-8 DIGITAL CONTROL ASSEMBLIES, SERVICE SHEETS 6E-5

6F-INPUTS/OUTPUTS

6F-1 INPUTS/OUTPUTS ASSEMBLIES: A27 and A29 PCBs 6F-1

6F-2 INPUTS/OUTPUTS ASSEMBLIES, OVERALL DESCRIPTION 6F-1

6F-3 A27 AUXILLARY I/O PCB, DETAILED CIRCUIT DESCRIPTION 6F-2

6F-4 A29 REAR PANEL INTERFACE PCB, GENERAL DESCRIPTION 6F-2

6F-5 A27 AUXILLARY I/O PCB, DETAILED CIRCUIT DESCRIPTION 6F-3

6F-6 A29 REAR PANEL INTERFACE PCB, DETAILED CIRCUIT DESCRIPTION 6F-3
- 6F-6.1 Microprocessor Interface 6F-3
- 6F-6.2 12 Bit DACs 6F-4
- 6F-6.3 Step Attenuator and Relay Drivers 6F-4
- 6F-6.4 PIN Switch Drivers 6F-4
- 6F-6.5 PIN Mode Shaper 6F-5
- 6F-6.6 PIN Current Drivers 6F-5

6F-7 INPUTS/OUTPUTS ASSEMBLIES, TROUBLESHOOTING 6F-6

6F-8 INPUTS/OUTPUTS ASSEMBLIES, SERVICE SHEETS 6F-6

6G-REFERENCE LOOP

6G-1 REFERENCE LOOP ASSEMBLIES: A5, A7, A10 PCBs AND CRYSTAL OSCILLATOR 6G-1

6G-2 REFERENCE LOOP ASSEMBLIES, OVERALL DESCRIPTION 6G-1

SECTION VI
SERVICE

CONTENTS (Continued)

Paragraph Description Page

6G-3 A5 REFERENCE OSCILLATOR, DETAILED CIRCUIT DESCRIPTION 6G-2
  6G-3.1 Loop Amplifier 6G-2
  6G-3.2 Oscillator 6G-2
  6G-3.3 Buffer Amplifiers 6G-2

6G-4 A7 REFERENCE DIVIDER PCB, DETAILED CIRCUIT DESCRIPTION 6G-2
  6G-4.1 500 MHz Input 6G-2
  6G-4.2 Divide-by Five 6G-3
  6G-4.3 10 MHz Input Circuit 6G-3
  6G-4.4 External 10 MHz Input Circuit 6G-3
  6G-4.5 Phase/Frequency Detector 6G-3

6G-5 A10 REFERENCE BUFFER PCB, DETAILED CIRCUIT DESCRIPTION 6G-4
  6G-5.1 Input 6G-4
  6G-5.2 Buffer Amplifiers 6G-4

6G-6 REFERENCE LOOP ASSEMBLIES, TROUBLESHOOTING 6G-4

6G-7 REFERENCE LOOP ASSEMBLIES, SERVICE SHEETS 6G-4

6H-COARSE LOOP

6H-1 COARSE LOOP ASSEMBLIES: A3, A4, AND A6 PCBs

6H-2 COARSE LOOP ASSEMBLIES, OVERALL DESCRIPTION 6H-1

6H-3 A3 COARSE LOOP MIXER, DETAILED CIRCUIT DESCRIPTION 6H-2
  6H-3.1 Local Oscillator (LO) Input 6H-2
  6H-3.2 RF Input 6H-2
  6H-3.3 Limiter/Amplifier 6H-2

6H-4 A4 COARSE LOOP OSCILLATOR, DETAILED CIRCUIT DESCRIPTION 6H-2
  6H-4.1 Input Amplifier 6H-2
  6H-4.2 Loop Amplifier 6H-2
  6H-4.3 Oscillator 6H-3
  6H-4.4 Buffer Amplifiers 6H-3

6H-5 A6 COARSE LOOP DIVIDER, DETAILED CIRCUIT DESCRIPTION 6H-3
  6H-5.1 10 MHz Reference Input 6H-3
  6H-5.2 Coarse Loop Mixer Input 6H-3
  6H-5.3 Serial Input Control 6H-3
  6H-5.4 Two-Modulus Prescalar 6H-4
  6H-5.5 Frame Counter (Divide-by-5/6 Counter) 6H-4
  6H-5.7 Fractional Division Control 6H-5
  6H-5.8 Phase/Frequency Detector 6H-5
  6H-5.9 Notch Filters 6H-6

6H-6 COARSE LOOP ASSEMBLIES, TROUBLESHOOTING 6H-7

6H-7 COARSE LOOP ASSEMBLIES, SERVICE SHEETS 6H-7

SECTION VI
SERVICE

CONTENTS (Continued)

Paragraph **Description** **Page**

6I-FINE LOOP

6I-1 FINE LOOP ASSEMBLIES: A9 AND A11 PCBs 6I-1

6I-2 FINE LOOP ASSEMBLIES, OVERALL DESCRIPTION 6I-1

6I-3 A9 FINE LOOP OSCILLATOR, DETAILED CIRCUIT DESCRIPTION 6I-2
  6I-3.2 Linearizer 6I-2
  6I-3.3 Oscillator 6I-2
  6I-3.4 Output Amplifiers 6I-2

6I-4 A11 FINE LOOP DIVIDER, DETAILED CIRCUIT DESCRIPTION 6I-3
  6I-4.1 10 MHz Input Circuit 6I-3
  6I-4.2 200-321 MHz Fine Loop Input 6I-3
  6I-4.3 Serial Input Circuits 6I-3
  6I-4.4 Counter Circuits 6I-3
  6I-4.5 Phase/Frequency Detector 6I-4
  6I-4.6 Notch Filters 6I-4

6I-5 FINE LOOP ASSEMBLIES, TROUBLESHOOTING 6I-5

6I-6 FINE LOOP ASSEMBLIES, SERVICE SHEETS 6I-5

6J-YIG LOOP/FM

6J-1 INTRODUCTION 6J-1
  6J-1.1 YIG Loop/FM Subsystem Overall Functional Description 6J-1

6J-2 A12 YIG PHASE DETECTOR PCB CIRCUIT DESCRIPTION 6J-3
  6J-2.1 Sampler/IF Amplifier Input Circuit 6J-3
  6J-2.2 200-321 MHz Fine Loop Oscillator Input and Divider Circuits 6J-4
  6J-2.3 Phase/Frequency Detector Circuit 6J-4
  6J-2.4 External 20-32.1 MHz Synthesizer Input 6J-4

6J-3 A16 FM PCB CIRCUITS DESCRIPTION 6J-5
  6J-3.1 Digital Control 6J-5
  6J-3.2 A16 YIG Phase-Lock Circuits 6J-5
  6J-3.3 FM Input Amplifiers and Filters 6J-5
  6J-3.4 FM Attenuator Circuits 6J-6
  6J-3.5 FM Integrator Circuits 6J-6
  6J-3.6 False Lock Detector 6J-6
  6J-3.7 Notch Filter Circuits 6J-8
  6J-3.8 YIG Loop Amplifier 6J-8
  6J-3.9 FM Deviation Limiter 6J-8
  6J-3.10 FM Sensitivity Circuit 6J-9

6J-4 A31 MULTIPLIER/POWER AMPLIFIER ASSEMBLY 6J-9

SECTION VI
SERVICE

CONTENTS (Continued)

Paragraph Description Page

6J-5 A30 SAMPLER/IF AMPLIFIER ASSEMBLY CIRCUIT DESCRIPTION 6J-9
  6J-5.1 Sampler Circuits 6J-9
  6J-5.2 IF Preamplifier 6J-9
  6J-5.3 72 MHz Low Pass Filter 6J-9
  6J-5.4 Limiter Circuit 6J-9

6J-6 YIG LOOP ASSEMBLIES, TROUBLESHOOTING 6J-10

6J-7 YIG LOOP ASSEMBLIES SERVICE SHEETS 6J-10

6K-ANALOG INSTRUCTION

6K ANALOG INSTRUCTION A17 PCB

6K-1 ANALOG INSTRUCTION ASSEMBLY: A17 PCB 6K-1

6K-2 ANALOG INSTRUCTION ASSEMBLY, OVERALL DESCRIPTION 6K-1

6K-3 MICROPROCESSOR INTERFACE AND INTERNAL DATA BUS, GENERAL DESCRIPTION 6K-2

6K-4 RAMP GENERATOR, GENERAL DESCRIPTION 6K-2

6K-5 ±10V REFERENCE SUPPLIES, GENERAL DESCRIPTION 6K-3

6K-6 FREQUENCY INSTRUCTION, GENERAL DESCRIPTION 6K-3

6K-7 DIGITAL VOLTMETER (DVM), GENERAL DESCRIPTION 6K-4

6K-8 POWER METER, GENERAL DESCRIPTION 6K-5

6K-9 MICROPROCESSOR BUS INTERACE AND INTERNAL DATA BUS, DETAILED CIRCUIT DESCRIPTIONS 6K-7

6K-10 RAMP GENERATOR CIRCUITS, DETAILED CIRCUIT DESCRIPTIONS 6K-8
  6K-10.1 Ramp Integrator 6K-8
  6K-10.2 Marker-Switch point DAC 6K-8
  6K-10.3 Marker-Switch Point Comparator 6K-8
  6K-10.4 Ramp Control Logic 6K-9

6K-11 ±10V REFERENCE SUPPLIES, DETAILED CIRCUIT DESCRIPTION 6K-11

6K-12 FREQUENCY INSTRUCTION, DETAILED CIRCUIT DESCRIPTION 6K-11
  6K-12.1 Tune DAC 6K-11
  6K-12.2 Sweep Width DAC 6K-11
  6K-12.3 Analog Sweep Correction 6K-12
  6K-12.4 Linearizer DAC 6K-13

6K-13 DIGITAL VOLTMETER, DETAILED CIRCUIT DESCRIPTION 6K-14

SECTION VI
SERVICE

CONTENTS (Continued)

Paragraph Description Page

6K-14 POWER METER, DETAILED CIRCUIT DESCRIPTION 6K-15
  6K-14.1 Input Chopper Amplifier 6K-15
  6K-14.2 Programmable Gain Amplifier 6K-16
  6K-14.3 Synchronous Detector 6K-16
  6K-14.4 Temperature Compensation and Offset Amplifiers 6K-16

6K-15 ANALOG INSTRUCTION PCB, TROUBLESHOOTING 6K-16

6K-16 ANALOG INSTRUCTION PCB, SERVICE SHEETS 6K-16

6L-YIG DRIVERS

6L-1 INTRODUCTION 6L-1
  6L-1.1 YIG Driver PCB Versions 6L-1

6L-2 YIG DRIVER PCBs, CIRCUIT DESCRIPTION 6L-1
  6L-2.1 A18-A21 YIG Driver PCB Addressing 6L-1
  6L-2.2 FM Coil Driver 6L-1
  6L-2.3 Main Tuning Coil Driver 6L-1
  6L-2.4 Bias Supply Driver Circuits 6L-2

6L-3 YIG DRIVER PCBs TROUBLESHOOTING 6L-2

6L-4 YIG DRIVER PCBs SERVICE SHEETS 6L-2

6M-ALC/PULSE MODULATION

6M-1 ALC (AUTOMATIC LEVEL CONTROL) AND PULSE MODULATION PCBs AND ASSEMBLIES 6M-1
  6M-1.1 Overview of ALC Loop Operation 6M-1
  6M-1.2 A15 ALC PCB Functional Description 6M-1
  6M-1.3 A13 Pulse Generator PCB Circuit Description 6M-7
  6M-1.5 ALC Loop Microwave Deck Components 6M-12

6M-2 ALC/PULSE MODULATION SUBSYSTEM SCHEMATICS 6M-12

6M-3 RF POWER AND CONTROL SUBSYSTEM TROUBLESHOOTING 6M-12

6N-POWER SUPPLY

6N-1 POWER SUPPLY ASSEMBLIES: A22, A25, AND PART OF A28 PCBs 6N-1

6N-2 POWER SUPPLY ASSEMBLIES, OVERALL DESCRIPTION 6N-1

6N-3 POWER SUPPLY ASSEMBLIES, DETAILED DESCRIPTION 6N-2

6N-4 A25 SWITCHING POWER SUPPLY, DETAILED CIRCUIT DESCRIPTION 6N-3

6N-5 A22 REGULATOR INTERFACE PCB, DETAILED CIRCUIT DESCRIPTION 6N-5

6N-6 A28 MOTHERBOARD PCB POWER SUPPLY CIRCUITS, DETAILED CIRCUIT DESCRIPTION 6N-6

SECTION VI
SERVICE

CONTENTS (Continued)

Paragraph **Description** **Page**

6N-7 POWER SUPPLY ASSEMBLIES, TROUBLESHOOTING 6N-6

6N-8 POWER SUPPLY ASSEMBLIES, SERVICE SHEETS 6N-6

6P-MOTHERBOARD/INTERCONNECTIONS

6P-1 INTRODUCTION 6P-1

6P-2 OVERALL DESCRIPTION 6P-1

6P-3 A28 MOTHERBOARD AND CABLE INTERCONNECTS 6P-1
- 6P-3.1 Motherboard/Interconnect Circuits Description 6P-1
- 6P-3.2 Filtercons 6P-2
- 6P-3.3 Wiring Harnesses/Ribbon Cables 6P-2
- 6P-3.4 RF Casting Coaxial Cables 6P-2
- 6P-3.5 Microwave Deck Interconnections 6P-2

6P-4 A28 MOTHERBOARD TROUBLESHOOTING 6P-2

6Q-MICROWAVE DECK

6Q-1 RF MICROWAVE DECK ASSEMBLY 6Q-1

6Q-2 RF MICROWAVE DECK ASSEMBLY, OVERALL DESCRIPTION 6Q-1

6Q-3 FREQUENCY BANDS 2 THRU 4, CIRCUIT DESCRIPTION 6Q-3
- 6Q-3.1 Frequency Control and FM Modulation 6Q-3
- 6Q-3.2 Power Level Control and AM Modulation 6Q-3
- 6Q-3.3 Pulse Modulation 6Q-3
- 6Q-3.4 Output Control 6Q-3
- 6Q-3.5 Power Level Detection/ALC Loop 6Q-4

6Q-4 FREQUENCY BANDS 0 AND 1, CIRCUIT DESCRIPTION 6Q-4
- 6Q-4.1 Down Converter 6Q-4
- 6Q-4.2 Switched Filter 6Q-4
- 6Q-4.3 RF Output 6Q-5

6Q-5 FREQUENCY BAND 5, CIRCUIT DESCRIPTION 6Q-5
- 6Q-5.1 DPDT PIN Switch 6Q-5
- 6Q-5.2 Frequency Doubler/Amplifier 6Q-5
- 6Q-5.3 RF Output 6Q-5

6Q-6 RF MICROWAVE DECK ASSEMBLY, SERVICE SHEETS 6Q-5

6Q-7 RF MICROWAVE DECK ASSEMBLY, SERVICE SHEETS 6Q-5

SECTION 6A
SERVICE INTRODUCTION

6A-1 INTRODUCTION

This section contains service information for the 67XXA Swept Frequency Synthesizer. The material in this section is arranged in the following order:

- General reference information
- Overall instrument theory and block diagram;
- Overall instrument troubleshooting aids;
- Individual subsystem groups (of PCBs);
- Power supply circuits;
- Motherboard and cable interconnections;
- Microwave deck components.

The circuitry of the 67XXA is divided into various subsystems that are contained on one or more printed circuit boards (PCBs) or are contained in microwave components that are located on the microwave deck of the synthesizer. Table 6A-1 lists all of the PCBs and circuit assemblies that are common to all models of the 67XXA. Refer to Section 5–Parts Lists for a complete listing of all major 67XXA assemblies, including those of the microwave deck.

Each subsystem is described in a separate subsection in this manual. All service data (schematics, circuit description, block diagrams, etc.) that affect a particular subsystem are contained within the subsection for that subsystem. For example, all schematics and other service data bearing on the power supply subsystem are contained within paragraphs 6N-x located in Subsection 6N. This includes the one page of the A28 Motherboard schematic that contains power supply circuitry.

6A-2 GENERAL INFORMATION

6A-2.1 Model Frequency Coverage

The frequency coverage of each model of 67XXA synthesizer is listed in Table 6A-2, which is located at the rear of this section. Note that this table also denotes those models that have down-converter and/or frequency doubler microwave components and circuitry installed.

Table 6A-1. Replaceable Subassemblies

REPLACEMENT ASSEMBLY NAME	WILTRON P/N
A1/A2 Front Panel Assembly	6700A-D-31930
A3 Coarse Loop Mixer PCB	6700A-D-31703-3
A4 Coarse Loop Oscillator PCB	6700A-D-31704-3
A5 Reference Oscillator PCB	6700A-D-31705-3
A6 Coarse Loop Divider PCB	6700A-D-31706-3
A7 Reference Divider PCB	6700A-D-31707-3
A8 Serial I/O PCB	6700A-D-31708-3
A9 Fine Loop Oscillator PCB	6700A-D-31709-3
A10 Reference Buffer PCB	6700A-D-31710-3
A11 Fine Loop Divider PCB	6700A-D-31711-3
A12 YIG Phase Detector PCB	6700A-D-31712-3
A13 Pulse Generator PCB	6700A-D-31713-3
A15 ALC PCB	6700A-D-31715-3
A16 FM PCB	6700A-D-31716-3
A17 Analog Instruction PCB	6700A-D-31717-3
A18 2-8 GHz YIG Driver PCB *	6700A-ND-34071
A19 8-12 GHz YIG Driver PCB *	6700A-ND-34072
A20 12-20 GHz YIG Driver PCB *	6700A-ND-34073
A21 20-26.5 GHz YIG Driver PCB *	6700A-ND-34074
A22 Regulator Interface PCB	6700A-ND-34075
A23 Microprocessor PCB	6700A-D-31723-3
A24 GPIB PCB	6700A-D-31724-3
A25 Power Supply PCB	6700A-D-31725-3
A26 Line Filter	6700A-D-31726-3
A27 Auxiliary I/O PCB	6700A-D-31727-3
A29 Rear Panel Interface PCB	6700A-D-31729-3
Crystal Oscillator Assembly	6700A-C-31924
Microwave Deck Components–	Refer to Table 5-40.

* Depending on the 67XXA model, some or all of these PCBs will be included.

6A-2.2 Replaceable Subassemblies and Parts

Table 6A-1 is a *partial* listing of the replaceable subassemblies for the 67XXA series of synthesizers. It lists all of the PCBs and circuit assemblies that are *common* to all models of the 67XXA. Table 5-40, located in Section 5–Parts Lists, is a listing of all replaceable microwave deck components.

The other parts lists and figures included in Section 5 identify the main components of each major 67XXA assembly. The parts lists for each PCB assembly (A1–A29) includes all replaceable parts contained on that PCB.

6A-2.3 Module Exchange Program

WILTRON maintains a module exchange program for selected synthesizer modules (Table 6A-1). If a malfunction occurs in one of these modules, the module can be exchanged. Upon request and typically within 24 hours, WILTRON will ship an exchange module. The customer then has 30 days in which to return the defective item. All exchange parts are warranted for 90 days from the date of shipment or for the balance of the original-part warranty—whichever is longer.

For more information on this program, contact your local sales representative or call WILTRON Customer Service at 408-778-2000.

6A-2.4 Preventive Maintenance

The rear panel fan on the 67XXA has a two-part air filter. The exterior filter element should be periodically checked and cleaned as needed. The interior honeycomb element should also be checked and cleaned each time the exterior element is removed.

6A-2.5 Recommend Test Equipment

Table 1-3, located in Section 1–General Information, provides a list of recommended test equipment. Equipment that is recommended for troubleshooting is identified with a "T" in the "USE" column of the table.

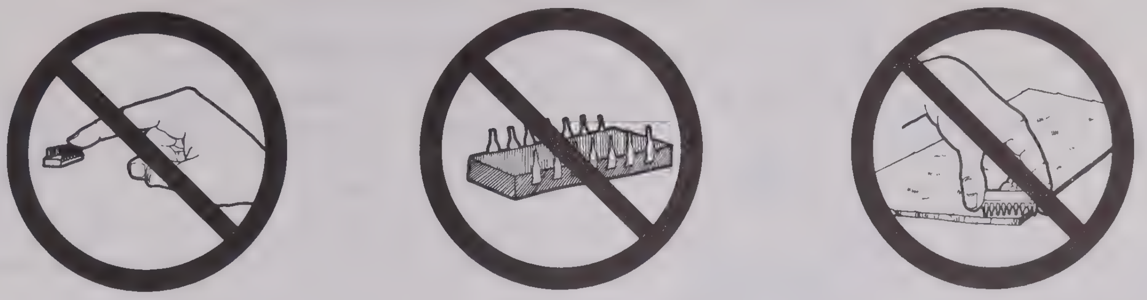
6A-2.6 Schematic Conventions

The schematic conventions used in this manual are described below.

- Signal flow is from left to right. All signals entering the PCB do so on the left of the page and those exiting the PCB do so on the right of the page.
- The arrow points of the signal flags indicate the direction of signal flow.
- The lettering in the signal flags indicate the sheet and grid coordinates of the signal destination (for outputs), or the point of signal origination (for inputs). The Sheet number is designated first.
- The arrow points on the end of connector lines indicate plugs. The arrow tails on the end of connector lines indicate jacks.
- Signal lines are identified by a distinctive name, mnemonic symbol, or voltage value. The letters "H" and "L" in front of digital signal lines indicate the line's active state—H for TTL high and L for TTL low. The "(-)" symbol that follows certain analog signal lines indicates a negative value.

6A-2.7 Static Handling Procedures

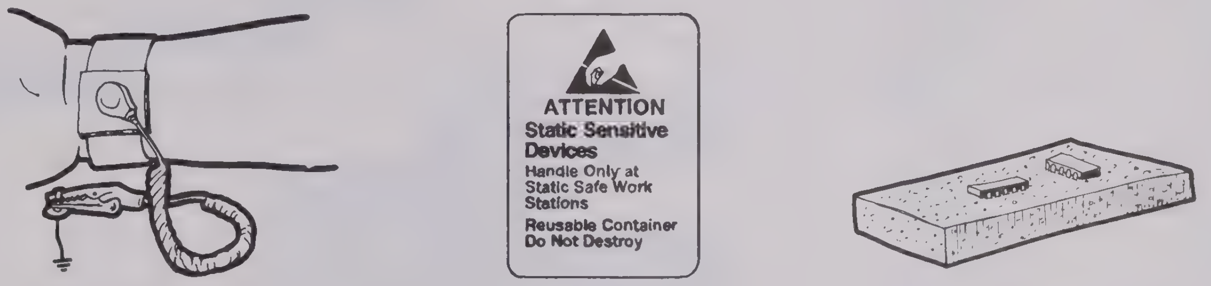
The 67XXA synthesizer contains components that are subject to being damaged by static electricity. Refer to Figure 6A-1, which provides a list of precautions for handling static-sensitive components. If followed, these precautions will minimize the possibilities of static-shock damage to these components.



1. Do not touch exposed contacts on any static sensitive component.

2. Do not slide static sensitive components across any surface.

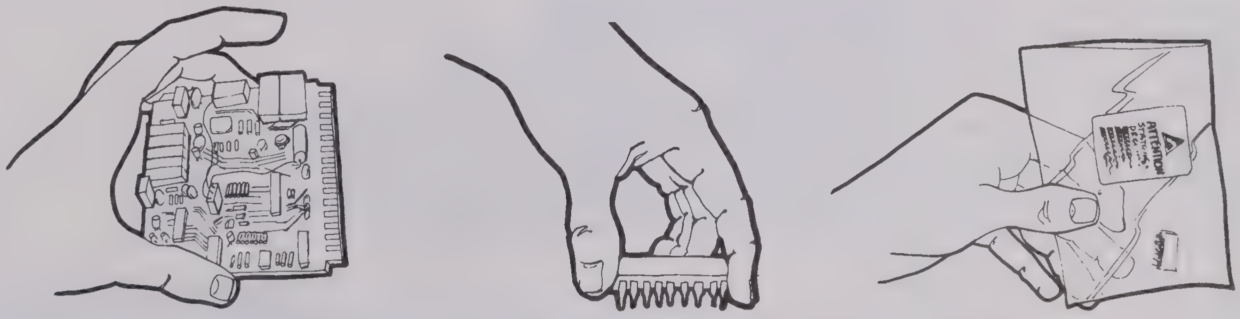
3. Do not handle static sensitive components in areas where the floor or work surface covering is capable of generatng a static charge.


ATTENTION
Static Sensitive Devices
Handle Only at Static Safe Work Stations
Reusable Container Do Not Destroy

4. Wear a static-discharge wristband when working with static sensitive components.

5. Label all static sensitive devices.

6. Keep component leads shorted together whenever possible.



7. Handle PCBs only by their edges. Do not handle by the edge connectors.

8. Lift and handle sold state devices by their bodies – never by their leads.

9. Transport and store PCBs and other static sensitive devices in static-shielded containers.

10. ADDITIONAL PRECAUTIONS:
- Keep workspaces clean and free of any objects cabable of holding or storing an electric charge.
- Connect soldering tools to an earth ground.
- Use only special anti-static suction or wick-type desoldering tools.

Figure 6A-1. Static Sensitive Device Precautions

Table 6A-2. Frequency Coverage for 67XXA Models

MODEL	TYPE	PWR OUT	FREQUENCY COVERAGE (GHz)					
			BAND 0	BAND 1 S/C BAND	BAND 2 X BAND	BAND 3 Ku BAND	BAND 4 K BAND	BAND 5 Ka BAND
			DOWN-CONVERTER BAND	FUNDAMENTAL OSCILLATORS				FREQUENCY DOUBLER BAND
			.01	2.0	8.0 8.4	12.4	18.0 20.0	26.5 40.0
6709A 6709A-40	SINGLE BAND	10 mW 40 mW	▨					
6719A		20 mW		▨	▨			
6728A 6728A-40		20 mW 40 mW			▨			
6730A 6730A-40		20 mW 40 mW				▨		
6736A		5 mW				▨	▨	
6740A		10 mW						▨
6721A 6721A-20	MULTI-BAND	10 mW 20 mW		▨	▨			
6729A 6729A-20		10 mW 20 mW			▨	▨		
6737A 6737A-20		10 mW 20 mW		▨	▨	▨		
6753A 6753A-10		3 mW * 10 mW		▨	▨	▨	▨	
6717A 6717A-20		10 mW 20 mW	▨	▨	▨			
6722A 6722A-20		10 mW 20 mW	▨	▨	▨			
6747A 6747A-20		10 mW 20 mW	▨	▨	▨	▨		
6759A 6759A-10		3 mW * 10 mW	▨	▨	▨	▨	▨	
6742A		5 mW				▨	▨	▨
6763A		3 mW *		▨	▨	▨	▨	▨
6769A		3 mW *	▨	▨	▨	▨	▨	▨

* 10 mW ≤20 GHz
3 mW >20 GHz

6B THEORY/BLOCK DIAGRAM

6B-1 INTRODUCTION

This section provides an overall description of the major circuit subsystems that comprise the synthesizer. Paragraphs 6B-2 and 6B-3 contain information about the mechanical and electrical construction and content of the synthesizer. Paragraph 6B-4 is a brief overview of the frequency synthesis functions of the 67XXA, including the Reference Loop, Course Loop, Fine Loop, and YIG Loops. Paragraph 6B-5 is a brief overview of the ALC and modulation functions of the synthesizer.

Sections 6D through 6Q in this manual provide detailed circuit theory for each specific group of PCBs (i.e., each subsystem). These sections also include troubleshooting procedures (to the PCB level) for these circuits.

6B-2 INSTRUMENT MECHANICAL LAYOUT

The 67XXA Swept Frequency Synthesizer contains 25-28 printed circuit boards (PCBs), a front panel assembly, rear panel assembly, and a number of microwave components/microcircuits (mounted on the Microwave Deck). The exact number of PCBs contained in the instrument will vary, depending upon the number of YIG Driver PCBs included for the specific model. The layout of the instrument with covers removed is shown in Figures 5-3 and 5-4 of Section 5–Parts Lists. The figures and parts lists contained in Section 5 for the major assemblies of the synthesizer identify the main components of each assembly.

6B-3 CIRCUIT SUBSYSTEMS

The 67XXA is comprised of the groups of PCBs (i.e., subsystems) listed below; a brief description of each subsystem is also included. The overall instrument block diagram shown in Figure 6B-2 (page 6B-8) reflects this organization.

6B-3.1 Front Panel Assembly (A1 and A2 PCBs)

This circuit subsystem interfaces the front panel keys and DEC/INCR knob to the A23 Microprocessor PCB. It consists of the A1 Front Panel PCB and the A2 Front Panel Control PCB. Refer to Section 6D–Front Panel for further theory information.

6B-3.2 Digital Control/GPIB Interface (A8, A23, and A24 PCBs)

This circuit subsystem provides microprocessor control for the synthesizer circuits and provides the GPIB functions for the synthesizer. The microprocessor control portion of this subsystem consists of the A23 Microprocessor, and the A8 Serial I/O PCBs. The GPIB functions, which allow the synthesizer to interface with an external network analyzer/controller, are provided by the A24 GPIB PCB. Refer to Section 6E–Digital Control for further theory information.

6B-3.3 Inputs/Outputs (A27 PCB and part of A29 PCB)

The A27 Auxiliary I/O PCB and the A29 Rear Panel Interface PCB contain the interface circuitry for most of the front and rear panel input/output connectors and switches, including the AUX I/O connector. Refer to Section 6F–Inputs/Outputs for further theory information.

6B-3.4 Frequency Synthesis Subsystem–RF Casting (A3-A7, A9-A12 PCBs)

This circuit subsystem provides the reference frequencies and phase lock circuits for precise control of the YIG oscillator frequency. This subsystem is further divided into the four smaller subsystems described below.

- Reference Loop – This subsystem provides the overall reference for the rest of the frequency synthesis subsystem. It consists of the 10 MHz Crystal Oscillator assembly, the A5 Reference Oscillator PCB, the A7 Reference Divider PCB, and the A10 Reference Buffer PCB. Refer to paragraph 6B-4 and to Section 6G–Reference Loop for further theory information.
- Coarse Loop – This subsystem provides the coarse frequency tuning frequencies for the YIG Loop. It consists of the A3 Coarse Loop Mixer PCB, the A4 Coarse Loop Oscillator PCB, and the A6 Coarse Loop Divider PCB. Refer to paragraph 6B-4 and to Section 6H–Coarse Loop for further theory information.
- Fine Loop – This subsystem provides the fine frequency tuning frequencies for the YIG Loop. It consists of the A9 Fine Loop Oscillator PCB and the A11 Fine Loop Divider PCB. Refer to paragraph 6B-4 and to Section 6I–Reference Loop for further theory information.

- YIG Loop/FM – This subsystem provides the phase detector and correction voltages for phase locking the YIG oscillators to the Coarse and Fine Loop frequencies. This loop also includes circuitry for FM modulation of the YIG loop via external FM input signals. It consists of the A12 YIG Phase Detector PCB and part of the A16 FM PCB. For further theory information, refer to paragraph 6B-4 and to Section 6J–YIG Loop /FM.

6B-3.5 Analog Instruction (A17 PCB)

The A17 Analog Instruction PCB provides the analog voltages and sweep ramp for control of the YIG oscillators. It also provides the power meter and digital voltmeter interface to the microprocessor. Refer to Section 6K–Analog Instruction for further theory information.

6B-3.6 YIG Drivers (A18-A21 PCBs)

These PCBs provide the tuning currents and bias voltages for control of the YIG oscillators. The actual number of these PCBs installed will depend on the frequency coverage of the 67XXA model. Refer to Section 6L–YIG Drivers for further theory information.

6B-3.7 ALC/Pulse Modulation (A13, A15 and p/o A29 PCBs)

This subsystem provides control of the RF output power for leveling, AM modulation, pulse modulation, and multiplexing of the YIG oscillator outputs. It consists of the A15 ALC PCB, the A13 Pulse Generator PCB, and part of the A29 Rear Panel Interface PCB. Refer to Section 6M–ALC/Pulse Modulation for further theory information.

6B-3.8 Power Supply (A22, A25, A26 PCBs and p/o A28 PCB)

These PCBs supply regulated voltages to the synthesizer circuits. The subsystem consists of the A25 Switching Power Supply PCB, A26 Line Filter PCB, A22 Regulator PCB, and part of the A28 Motherboard PCB. Refer to Section 6N–Power Supply for further theory information.

6B-3.9 Motherboard/Interconnections

The A28 Motherboard PCB and associated cables provide the interconnections between internal components and assemblies throughout the synthesizer. The A28 PCB is described and an interconnection diagram provided in Section 6P–Motherboard/Interconnections.

6B-3.10 Microwave Deck

The shaded circuit elements shown in Figure 6B-1 are those related to the generation, modulation and control of the microwave frequency signals. These circuit elements include: YIG-tuned oscillators, 0.01 to 2 GHz Heterodyne Down Converter Module, Level Detector, Step Attenuator, and Control Modulators. The location and function of these components/microcircuits are described in Section 6Q–Microwave Deck.

6B-4 FREQUENCY SYNTHESIS CIRCUITS, FUNCTIONAL DESCRIPTION

The frequency synthesis circuits provide phase-lock control for the synthesizer output frequency. These circuits, comprising four loops, are distributed over eleven printed circuit boards (PCBs). The overall block diagram of these circuits is shown in Figure 6B-2. The operation of these four loops that comprise these circuits, Reference, Coarse, Fine, and YIG, is described briefly in paragraph 6B-4-1 below.

The four phase-lock loop subsystems, operating together, produce an accurately synthesized, low-noise RF output signal. The output frequency is selectable in 1 kHz increments from 10 MHz to 26.5 GHz. The output signal is ultimately derived from a single, precision, 10 MHz internal reference.

YIG oscillators are used to produce the actual RF output signal. Several YIG oscillators, each tunable over a different frequency range, may be installed to give the synthesizer broad frequency coverage (Figure 6B-1). Only one YIG oscillator is active at any given time. Refer also to Table 6A-2 (in Section 6A), which lists the frequency coverage for each 67XXA model and denotes those models that have down-converter and/or frequency doubler circuitry installed.

6B-4.1 Overall Operation

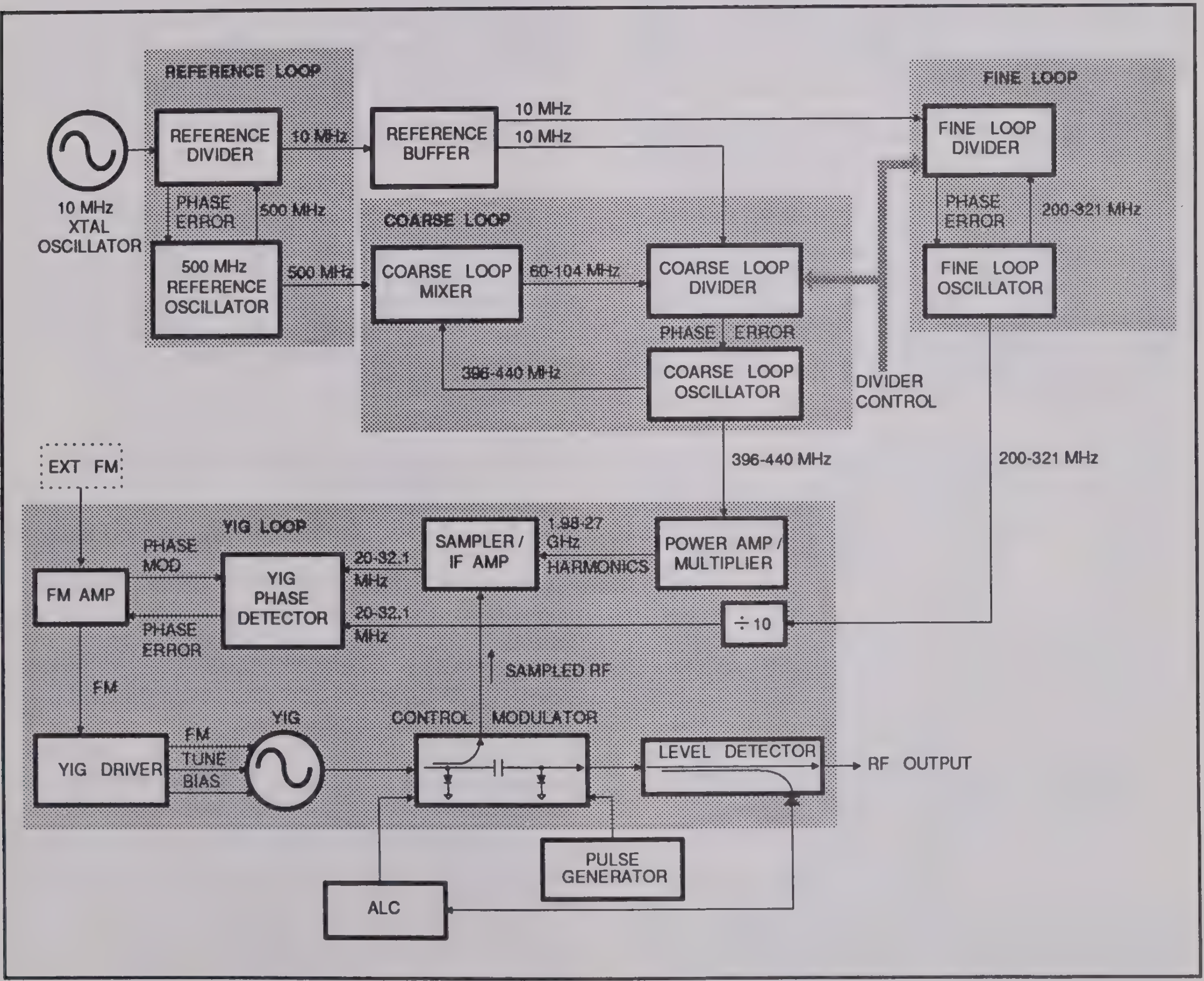
Refer to Figure 6B-1; the YIG oscillator generates a high-power RF output signal that has low broadband noise and low spurious content. Analog circuitry in the YIG driver coarsely tunes the oscillator to within a few megahertz of the final output frequency. The

YIG phase-lock loop is used to fine-tune the YIG oscillator to the exact output frequency and to reduce FM noise close to the carrier.

One input to the YIG-loop Sampler/IF Amplifier is a 198–220 MHz signal which is derived from the 396-440 MHz output from the coarse loop oscillator by the Power/Amp Multiplier assembly. This signal drives the step-recovery diode, which is part of the Power/Amp Multiplier assembly, to produce harmonics of the coarse-loop signal (1.98 to ≈ 27 GHz). These harmonics are used by the sampler circuits of the Sampler/IF Amplifier assembly.

The other input to the Sampler/IF Amplifier is a sample of RF power from the YIG oscillator output. Mixing the YIG output signal with the adjacent coarse-loop harmonic produces a low frequency difference signal which is the YIG IF signal (20-32.1 MHz).

The synthesizer main microprocessor programs the coarse-loop output frequency so that one of its harmonics will be within 20-32.1 MHz of the desired YIG operating frequency. The YIG Phase Detector compares the YIG IF signal to a 20–32.1 MHz frequency reference signal that is derived from the 200-321 MHz output from the fine-loop oscillator. The YIG phase detector fine tunes the YIG via the YIG FM coil driver to eliminate any frequency difference between the two signals. The resulting YIG output frequency is equal to the frequency of the selected course-loop harmonic plus $^1/_{10}$ the frequency of the fine-loop signal.


REFERENCE LOOP
10 MHz XTAL OSCILLATOR
REFERENCE DIVIDER
10 MHz
PHASE ERROR
500 MHz
500 MHz REFERENCE OSCILLATOR
500 MHz
REFERENCE BUFFER
10 MHz
10 MHz
FINE LOOP
FINE LOOP DIVIDER
PHASE ERROR
200-321 MHz
FINE LOOP OSCILLATOR
COARSE LOOP
COARSE LOOP MIXER
60-104 MHz
COARSE LOOP DIVIDER
PHASE ERROR
COARSE LOOP OSCILLATOR
396-440 MHz
DIVIDER CONTROL
396-440 MHz
200-321 MHz
EXT FM
YIG LOOP
PHASE MOD
FM AMP
YIG PHASE DETECTOR
PHASE ERROR
20-32.1 MHz
20-32.1 MHz
SAMPLER / IF AMP
1.98-27 GHz HARMONICS
POWER AMP / MULTIPLIER
÷10
SAMPLED RF
FM
YIG DRIVER
FM
TUNE
BIAS
YIG
CONTROL
MODULATOR
LEVEL DETECTOR
RF OUTPUT
PULSE GENERATOR
ALC

6B-1. Block Diagram of Frequency Synthesis Circuits

Phase locking the YIG over a broad frequency range is accomplished by programming the coarse-loop to various frequencies that have harmonics close to the desired operating frequencies. Exact frequency tuning for each desired operating frequency is accomplished by programming of the fine-loop oscillator. (In each case, the YIG oscillator is first tuned via its main tuning coil to the approximate desired operating frequency.)

The programming (tuning) range of the coarse-loop oscillator provides harmonics ≥1.98 GHz that can be set in steps of from one to several megahertz over a frequency range greater than or equal to the spacing between harmonics. An example of this is shown in Table 6B-1. Thus, any YIG output frequency can be downconverted to a YIG IF signal between 20-32.1 MHz. Since the coarse-loop output is synthesized, its frequency can be adjusted only in finite steps. The resulting harmonic steps may be as large as 12.1 MHz at high frequencies.

The YIG loop is fine tuned by varying the 20-32.1 MHz reference frequency signal applied to the YIG loop phase detector. This signal is derived by dividing the fine-loop oscillator signal by a factor of 10. By programming the fine-loop oscillator, this signal can be adjusted in 1 kHz increments over a 20–32.1 MHz range. The resolution of the fine-loop oscillator (hence the resolution of the RF output signal) is 1 kHz, which is much finer resolution than is available from the coarse-loop alone.

Table 6B-1. Example of Coarse-Loop Tuning Range vs Harmonic Spacing

Desired YIG Freq GHz	Coarse-Loop Freq MHz	Harmonic Number	Harmonic Freq GHz
2.000	198	10	1.980
2.198	198	11	2.178

NOTE

Whenever the synthesizer is operating in the phase-locked mode, the frequency of the YIG IF will always equal $^1/_{10}$ the frequency of the fine-loop oscillator.

For applications requiring resolution finer than 1 kHz, an external 20–32.1 MHz synthesizer can be connected at the rear panel to substitute for the internal fine-loop signal. The tuning resolution is then determined by the resolution of the external synthesizer.

The Coarse Loop and Fine Loop outputs are derived from high-stability 10 MHz and 500 MHz signals produced by the Reference Loop circuits. The 500 MHz oscillator frequency of the Reference Loop oscillator is precisely stabilized by locking it to the internal or external 10 MHz frequency standard.

6B-4.2 Down Converter Band (0.01-2.0 GHz)

The lowest YIG output frequency that is downconverted and controlled in the manner described above is 2.0 GHz. For those models with output frequencies of 0.01-2.00 GHz, the RF output signal is produced by downconverting 4.51-6.00 GHz signals from the low-band YIG using a 4.5 GHz signal derived from the 500 MHz Reference Loop Oscillator. The 0.1-2 GHz down converter circuit is shown in Figure 6B-1. (Refer also to Table 6A-2; this table lists the frequency coverage of each 67XXA model and denotes which units include a down converter.)

In the down converter mode of operation, the coarse-loop oscillator is programmed to produce harmonics approximately 4.5 GHz above the desired output frequency, and the fine-loop programming and YIG-loop tuning processes are performed in the normal manner. Note that the sample of the RF signal that is used for output leveling and power output control (via A15) is obtained *after* the down converter.

6B-4.3 Frequency Doubler Band (26.5-40.0 GHz)

For models that produce output frequencies from 26.5 GHz to 40.0 GHz, the RF output signal is produced by frequency-doubling 13.25-20 GHz signals from the band-three YIG. The frequency doubler circuit is shown in Figure 6B-1. (Refer also to Table 6A-2; this table lists the frequency coverage of each 67XXA model and denotes which units include a frequency doubler.)

In the frequency doubler mode of operation, the coarse-loop oscillator is programmed to produce harmonics approximately equal to one-half the desired output frequency, and the fine-loop programming and YIG-loop tuning processes are performed in the normal manner. Note that the sample of the RF signal that is used for output leveling and power output control (via A15) is obtained *after* the frequency doubler.

6B-4.4 FM Modulation Circuits

FM modulation of the YIG signal by external signals is performed by summing the external signals into the FM control path of the YIG loop. Refer to Figures 6B-1 and 6B-2; FM inputs from the front panel and rear panel are routed via the A28 Motherboard PCB to the FM Amplifier circuits located on the A16 FM Driver PCB. These circuits frequency modulate the YIG signal by controlling the YIG oscillator FM coil in the same manner as for the phase lock error signal from the YIG loop phase detector circuits.

6B-4.5 Sweep Mode Operation

Sweeps of the YIG frequency less than 50 MHz wide are accomplished by summing the appropriate analog sweep ramp signals generated by the A17 Analog PCB into the FM control path of the YIG loop in the same manner as described above. In this mode of operation, the YIG signal is swept about a center frequency that has been set by the phase locked tuning circuits.

Sweeps of the YIG frequency greater than 50 MHz wide are accomplished by applying appropriate sweep ramp signals generated by the A17 Analog PCB to the YIG main tuning coil (via the appropriate A18-A21 YIG Driver PCB). The synthesizer main microprocessor controls the A17 PCB to produce precisely controlled *start* and *stop* sweep frequencies. For those FM sweeps that cross over one or more YIG bands, the synthesizer main microprocessor controls the generation and timing of the ramp signals from the A17 PCB and the selection of the appropriate A18-A21 YIG Driver PCB(s) throughout the sweep.

6B-5 ALC AND MODULATION CIRCUITS, FUNCTIONAL DESCRIPTION

The ALC and modulation circuits provide automatic level control (ALC), AM modulation and pulse modulation of the synthesizer output signal. The ALC loop is comprised of circuits located on the A15 ALC PCB and part of the A29 Rear Panel Interface PCB that interface with the Control Modulator and Level Detector microwave components located on the microwave deck. AM modulation circuits (located on the A15 PCB) are included in this loop.

Pulse modulation of the synthesizer output signal is provided by circuits located on the A13 Pulse Generator PCB. These circuits interface directly with the control modulator components located on the microwave deck (Figure 6B-1).

The overall block diagram of the ALC and pulse modulation circuits is shown in Figure 6B-3 (page 6B-10). The operation of these circuits is described briefly in the paragraphs that follow.

6B-5.1 ALC Loop Operation

The ALC circuitry located on the A15 PCB controls the RF power output level of the synthesizer by comparing the output signal from the Level Detector (located on the microwave deck) against a *RF reference voltage* that represents the desired output level. If the two voltages do not match, an error correction signal is fed from the A15 ALC amplifier to the PIN driver circuits located on the A29 PCB. The PIN driver circuits cause the PIN level control diodes located in the Control Modulator to adjust the RF output level accordingly. Thus, the detected RF voltage will be set equal to the RF reference voltage.

The RF level reference voltage is produced by summing a precision dc reference voltage with the output from the Range and Level DACs, which are controlled by the synthesizer main microprocessor. By setting the output of these DACs to the appropriate voltage, the main microprocessor adjusts the RF output power to the level selected by the user. The desired output level may be set throughout a 12 dB range (standard) using either the front panel switches or via the GPIB. For those units with the 110 dB attenuator (Options 2A and 2C) the output level range is 0–122 dB, and for Option 2B the output level range is 0–102 dB.

a. Power Sweep Operation
In this mode of operation, the synthesizer main microprocessor controls the ALC circuitry to step the RF output signal through a range of output levels specified by the user. This feature can be used in conjunction with the sweep mode to produce a set of identical frequency sweeps, each with a different RF power output level.

b. AM Modulation Circuits
To provide AM modulation of the RF output signal, the external AM modulation signal from the front or rear panel inputs is summed with the precision dc reference voltage to produce a RF reference voltage that varies with the external

modulation signal. The action of the ALC leveling loop then causes the envelope of the RF output signal to match the external modulation signal.

c. ***Pulse Modulation Operation***
During the pulse modulation mode of operation, the RF Detector Preamplifier and one stage of the ALC amplifier (A15 PCB) are operated as sample/hold amplifiers. These amplifiers are synchronized with the modulating pulse from the A13 Pulse Generator PCB so that the ALC loop effectively operates only on the *ON* portion of the pulsed RF output waveform.

6B-5.2 A13 Pulse Generator PCB Operation

The 67XXA has three pulse modulation modes:

- Internal pulse modulation mode– In this mode, the pulse modulation waveform is generated internally.
- External PULSE mode– In this mode, the external pulse source signal from the front or rear panel connectors is interfaced directly to the PIN driver circuits.
- External GATE mode– In this mode, the external pulse source gates the internal pulse generator on and off.

The A13 PCB provides the internal pulse generating function for the synthesizer and interfaces the external pulse signal source to the pulse generation and PIN driver circuits in the external modes. This PCB contains four major circuit groups:

- 10-Hz-to-1-MHz programmable pulse generator,
- Source/Mode select control circuits,
- Current driver circuits for the pulse PIN diodes located in the control modulators.
- Microprocessor data interface circuits.

The paragraphs that follow describe these circuit groups. Refer also to Figure 6B-4 (page 6B-11), which is a simplified block diagram of the A13 Pulse Generator PCB.

a. ***Pulse Generator***
The 10 MHz reference signal from the A10 Reference Divider PCB is routed to the A13 pulse generator clock divider circuits. The 10 MHz is divided down to the clock signals that are used to trigger the Pulse Rep Frequency Counter and Pulse Width Counter circuits. The proper clock frequency for the desired pulse repetition frequency and pulse width is selected by the Pulse Clock Select multiplexer circuits under control of the synthesizer main microprocessor.

The Pulse Rep Frequency Counter produces a Pulse Rep Freq clock signal that goes to the Pulse Source Select circuit. This circuit gates the trigger signals to the pulse generation circuits according to the mode selected (under control of the synthesizer main microprocessor).

In the internal pulse generation mode of operation, the output of the Pulse Rep Frequency Counter is routed to the Pulse Start FF. When clocked by a clock from the clock divider circuits, this flip-flop is set, which then sets the Pulse FF.

The output from the Pulse FF triggers the Pulse Width Counter to start the count down of the pulse width. At the end of the count, the Pulse Stop FF is set, which resets the Pulse FF and reloads the Pulse Width Counter in preparation for the next pulse.

At the end of the pulse repetition rate period, the output of the Pulse Rep Frequency Counter changes state. This action triggers the Pulse Start FF again and the process repeats.

NOTE

> The pulse width must always be programmed to be less than the period of the pulse repetition rate.

The output of the Pulse FF is routed via a buffer circuit to the rear panel PULSE SYNC OUTPUT connector. This output is also routed to the input of the Pulse Resolution generator circuits.

The Pulse Resolution Generator circuits function as a delay line with three outputs that are delayed by 25, 50, and 75 nanoseconds. The selection of these outputs, OR'ed together with the output of the Pulse FF, provide 25 ns pulse width resolution for all internally generated pulses from 25 ns to 100 us pulse width.

b. *Source/Mode select control circuits*

In the internal mode of operation, the pulse source select circuits gate the Pulse Rep Freq clock signal through to the pulse generation circuits. The mode select circuits connect the output of the Pulse FF to the input to the pulse PIN driver circuits (via the 100 & 25 ns Pulse Resolution circuits).

In the external GATE mode of operation, the external pulse source signal controls the Pulse Source Select circuits. This causes the Pulse Rep Freq clock signal to the pulse generation circuits to be gated on and off according to the external pulse source waveform.

The gated Pulse Rep Freq clock signal sets the Gate Edge FF, which then sets—and is immediately reset by—the Gate Edge Clear FF. This action sets the Pulse FF; the generation of the remainder of the pulse is as described above.

NOTE

For proper operation, the period of the external pulse source signal must be greater than the sum of the pulse repetition rate period and pulse width of the internal pulse waveform. The pulse width of the external pulse source must also exceed that of the internal pulse.

If the period of the external pulse source signal is greater than a multiple of the internal pulse period, the modulation waveform will contain multiple pulses. This technique may be used to obtain pulse-burst modulation of the RF output signal.

In the external PULSE mode of operation, the mode select circuits select the external pulse source signal (from the front/rear panel input connectors) as the input to the pulse PIN driver circuits. The RF output signal is thus modulated with the external source waveform.

The output of the Mode Select circuit is routed to the A15 ALC PCB as the L SAMPLE/HOLD signal. This signal synchronizes the ALC leveling loop to the pulse-on portion of the pulse modulation waveform.

c. *Pulse PIN Drivers*

The output of the Mode Select circuit also goes to the Pulse Mux circuit. This multiplexer routes the pulse modulation signal to the proper PIN driver circuit for the band selected. The PIN drivers are high-speed high-current driver circuits that control the pulse PIN diodes located in the control modulators.

d. *Processor Interface Circuits*

The synthesizer main microprocessor controls the pulse generator to produce pulse modulation of the RF output signal per the commands received from either the front panel or via the GPIB. It talks to the A13 pulse generator through the A8 Serial I/O PCB. Serial-parallel interface circuits on the A13 PCB convert the serial data received from the A8 PCB into parallel data that is stored in control latches.

The serial data is clocked into the A13 PCB by the Pulse Generator Clock and the Pulse Trigger Clock from the A8 PCB. The data received with the Pulse Generator Clock is used to set the pulse frequency and pulse width. The data received with the Pulse Trigger Clock is used to select the operating mode and to select the appropriate PIN driver circuit.

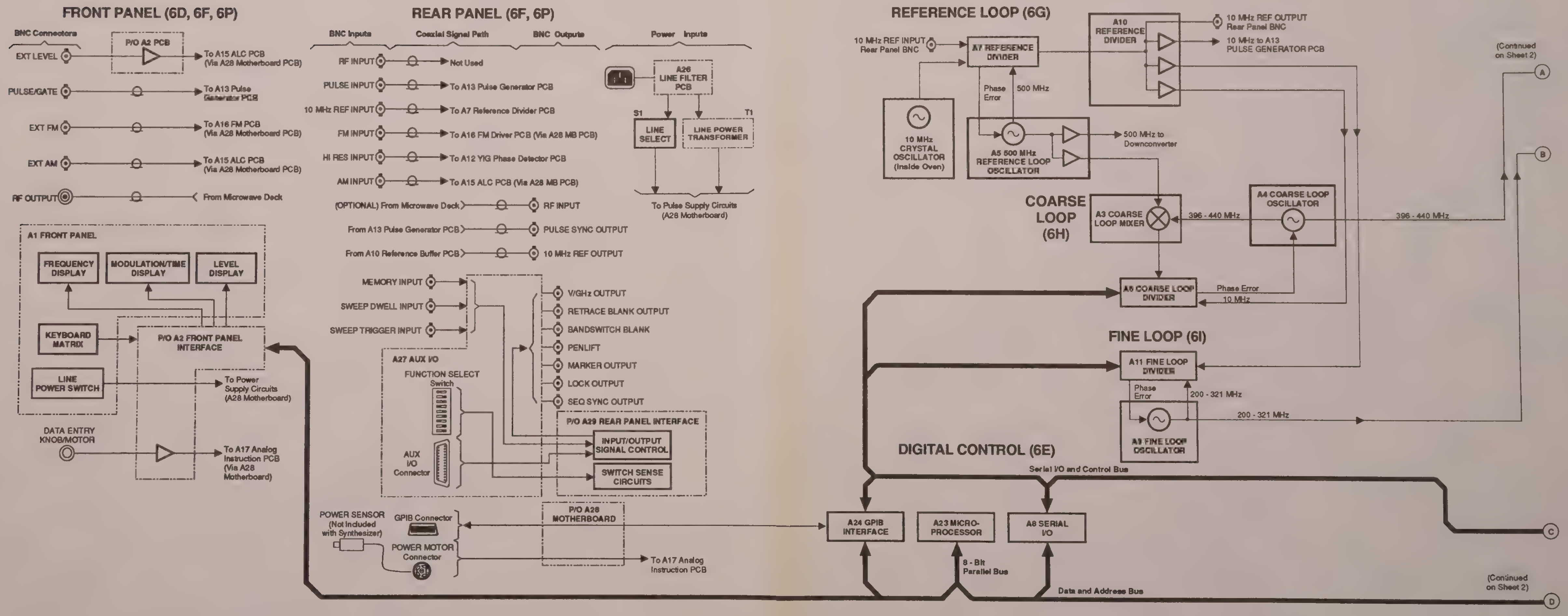

FRONT PANEL (6D, 6F, 6P)
BNC Connectors
P/O A2 PCB
EXT LEVEL
To A15 ALC PCB (Via A28 Motherboard PCB)
PULSE/GATE
To A13 Pulse Generator PCB
EXT FM
To A16 FM PCB (Via A28 Motherboard PCB)
EXT AM
To A15 ALC PCB (Via A28 Motherboard PCB)
RF OUTPUT
From Microwave Deck
A1 FRONT PANEL
FREQUENCY DISPLAY
MODULATION/TIME DISPLAY
LEVEL DISPLAY
KEYBOARD MATRIX
P/O A2 FRONT PANEL INTERFACE
LINE POWER SWITCH
To Power Supply Circuits (A28 Motherboard)
DATA ENTRY KNOB/MOTOR
To A17 Analog Instruction PCB (Via A28 Motherboard)
REAR PANEL (6F, 6P)
BNC Inputs
Coaxial Signal Path
BNC Outputs
RF INPUT
Not Used
PULSE INPUT
To A13 Pulse Generator PCB
10 MHz REF INPUT
To A7 Reference Divider PCB
FM INPUT
To A16 FM Driver PCB (Via A28 MB PCB)
HI RES INPUT
To A12 YIG Phase Detector PCB
AM INPUT
To A15 ALC PCB (Via A28 MB PCB)
(OPTIONAL) From Microwave Deck
RF INPUT
From A13 Pulse Generator PCB
PULSE SYNC OUTPUT
From A10 Reference Buffer PCB
10 MHz REF OUTPUT
MEMORY INPUT
SWEEP DWELL INPUT
SWEEP TRIGGER INPUT
V/GHz OUTPUT
RETRACE BLANK OUTPUT
BANDSWITCH BLANK
PENLIFT
MARKER OUTPUT
LOCK OUTPUT
SEQ SYNC OUTPUT
A27 AUX I/O
FUNCTION SELECT Switch
AUX I/O Connector
P/O A29 REAR PANEL INTERFACE
INPUT/OUTPUT SIGNAL CONTROL
SWITCH SENSE CIRCUITS
Power Inputs
A26 LINE FILTER PCB
S1
T1
LINE SELECT
LINE POWER TRANSFORMER
To Pulse Supply Circuits (A28 Motherboard)
POWER SENSOR (Not Included with Synthesizer)
GPIB Connector
POWER MOTOR Connector
P/O A28 MOTHERBOARD
To A17 Analog Instruction PCB
REFERENCE LOOP (6G)
10 MHz REF INPUT Rear Panel BNC
A7 REFERENCE DIVIDER
A10 REFERENCE DIVIDER
10 MHz REF OUTPUT Rear Panel BNC
10 MHz to A13 PULSE GENERATOR PCB
(Continued on Sheet 2)
Phase Error
500 MHz
10 MHz CRYSTAL OSCILLATOR (Inside Oven)
A5 500 MHz REFERENCE LOOP OSCILLATOR
500 MHz to Downconverter
COARSE LOOP (6H)
A3 COARSE LOOP MIXER
396 - 440 MHz
A4 COARSE LOOP OSCILLATOR
396 - 440 MHz
A6 COARSE LOOP DIVIDER
Phase Error
10 MHz
FINE LOOP (6I)
A11 FINE LOOP DIVIDER
Phase Error
200 - 321 MHz
200 - 321 MHz
A9 FINE LOOP OSCILLATOR
DIGITAL CONTROL (6E)
Serial I/O and Control Bus
A24 GPIB INTERFACE
A23 MICRO-PROCESSOR
A8 SERIAL I/O
8 - Bit Parallel Bus
Data and Address Bus
(Continued on Sheet 2)
A
B
C
D

Figure 6B-2. Typical 67XXA Swept Frequency Synthesizer, Block Diagram Showing Bands 0 Through 4 (Sheet 1 of 2)

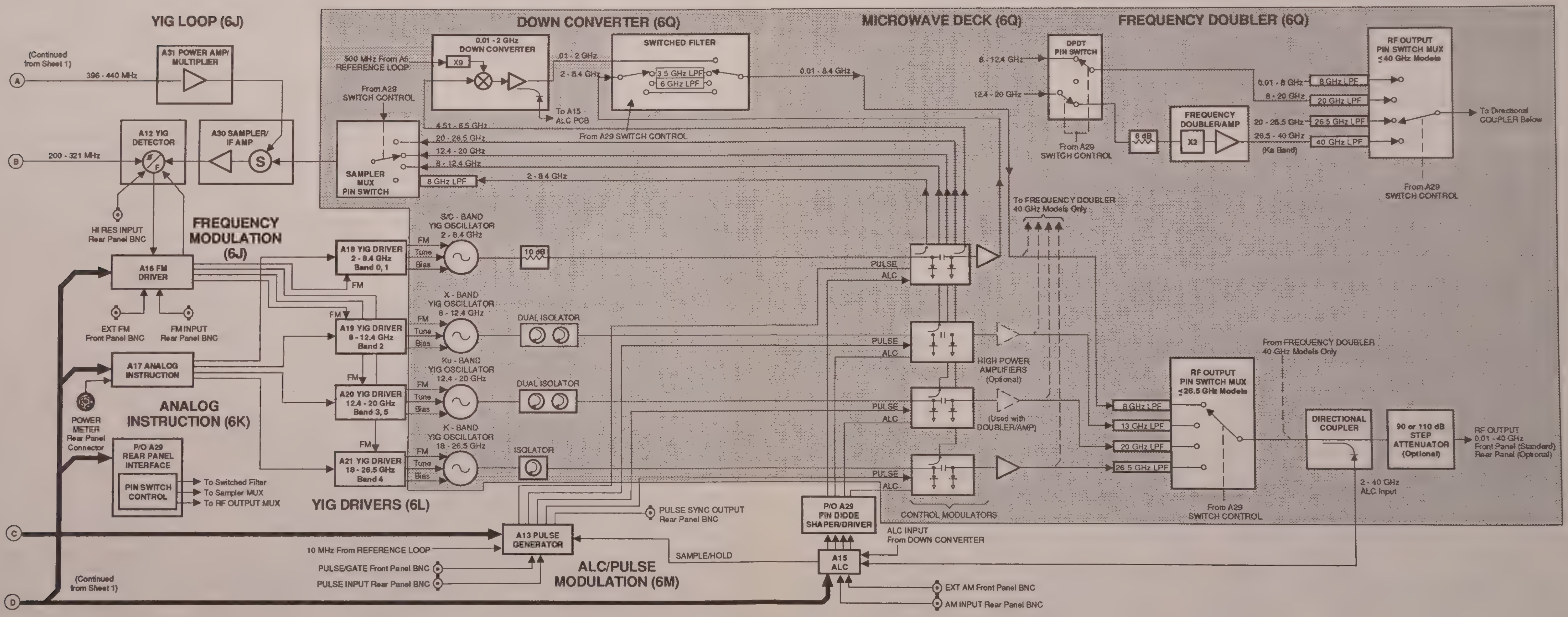

YIG LOOP (6J)
(Continued from Sheet 1)
A
396 - 440 MHz
A31 POWER AMP/ MULTIPLIER
B
200 - 321 MHz
A12 YIG DETECTOR
A30 SAMPLER/ IF AMP
S
HI RES INPUT Rear Panel BNC
FREQUENCY MODULATION (6J)
A16 FM DRIVER
EXT FM Front Panel BNC
FM INPUT Rear Panel BNC
A17 ANALOG INSTRUCTION
POWER METER Rear Panel Connector
ANALOG INSTRUCTION (6K)
P/O A29 REAR PANEL INTERFACE
PIN SWITCH CONTROL
To Switched Filter
To Sampler MUX
To RF OUTPUT MUX
DOWN CONVERTER (6Q)
500 MHz From A6 REFERENCE LOOP
From A29 SWITCH CONTROL
0.01 - 2 GHz DOWN CONVERTER
X9
.01 - 2 GHz
2 - 8.4 GHz
To A15 ALC PCB
SWITCHED FILTER
3.5 GHz LPF
6 GHz LPF
From A29 SWITCH CONTROL
0.01 - 8.4 GHz
SAMPLER MUX PIN SWITCH
4.51 - 6.5 GHz
20 - 26.5 GHz
12.4 - 20 GHz
8 - 12.4 GHz
8 GHz LPF
2 - 8.4 GHz
A18 YIG DRIVER 2 - 8.4 GHz Band 0, 1
FM
S/C - BAND YIG OSCILLATOR 2 - 8.4 GHz
FM
Tune
Bias
10 dB
A19 YIG DRIVER 8 - 12.4 GHz Band 2
FM
X - BAND YIG OSCILLATOR 8 - 12.4 GHz
DUAL ISOLATOR
A20 YIG DRIVER 12.4 - 20 GHz Band 3, 5
FM
Ku - BAND YIG OSCILLATOR 12.4 - 20 GHz
DUAL ISOLATOR
A21 YIG DRIVER 18 - 26.5 GHz Band 4
FM
K - BAND YIG OSCILLATOR 18 - 26.5 GHz
ISOLATOR
YIG DRIVERS (6L)
MICROWAVE DECK (6Q)
PULSE
ALC
HIGH POWER AMPLIFIERS (Optional)
(Used with DOUBLER/AMP)
CONTROL MODULATORS
To FREQUENCY DOUBLER 40 GHz Models Only
FREQUENCY DOUBLER (6Q)
DPDT PIN SWITCH
8 - 12.4 GHz
12.4 - 20 GHz
From A29 SWITCH CONTROL
6 dB
FREQUENCY DOUBLER/AMP
X2
0.01 - 8 GHz
8 - 20 GHz
20 - 26.5 GHz
26.5 - 40 GHz
(Ka Band)
8 GHz LPF
20 GHz LPF
26.5 GHz LPF
40 GHz LPF
RF OUTPUT PIN SWITCH MUX ≤40 GHz Models
To Directional COUPLER Below
From A29 SWITCH CONTROL
From FREQUENCY DOUBLER 40 GHz Models Only
RF OUTPUT PIN SWITCH MUX ≤26.5 GHz Models
8 GHz LPF
13 GHz LPF
20 GHz LPF
26.5 GHz LPF
From A29 SWITCH CONTROL
DIRECTIONAL COUPLER
2 - 40 GHz ALC Input
90 or 110 dB STEP ATTENUATOR (Optional)
RF OUTPUT 0.01 - 40 GHz Front Panel (Standard) Rear Panel (Optional)
C
D
(Continued from Sheet 1)
A13 PULSE GENERATOR
10 MHz From REFERENCE LOOP
PULSE/GATE Front Panel BNC
PULSE INPUT Rear Panel BNC
PULSE SYNC OUTPUT Rear Panel BNC
SAMPLE/HOLD
ALC/PULSE MODULATION (6M)
P/O A29 PIN DIODE SHAPER/DRIVER
ALC INPUT From DOWN CONVERTER
A15 ALC
EXT AM Front Panel BNC
AM INPUT Rear Panel BNC

Figure 6B-2. Typical 67XXA Swept Frequency Synthesizer, Block Diagram Showing Bands 0 Through 4 (Sheet 2 of 2)

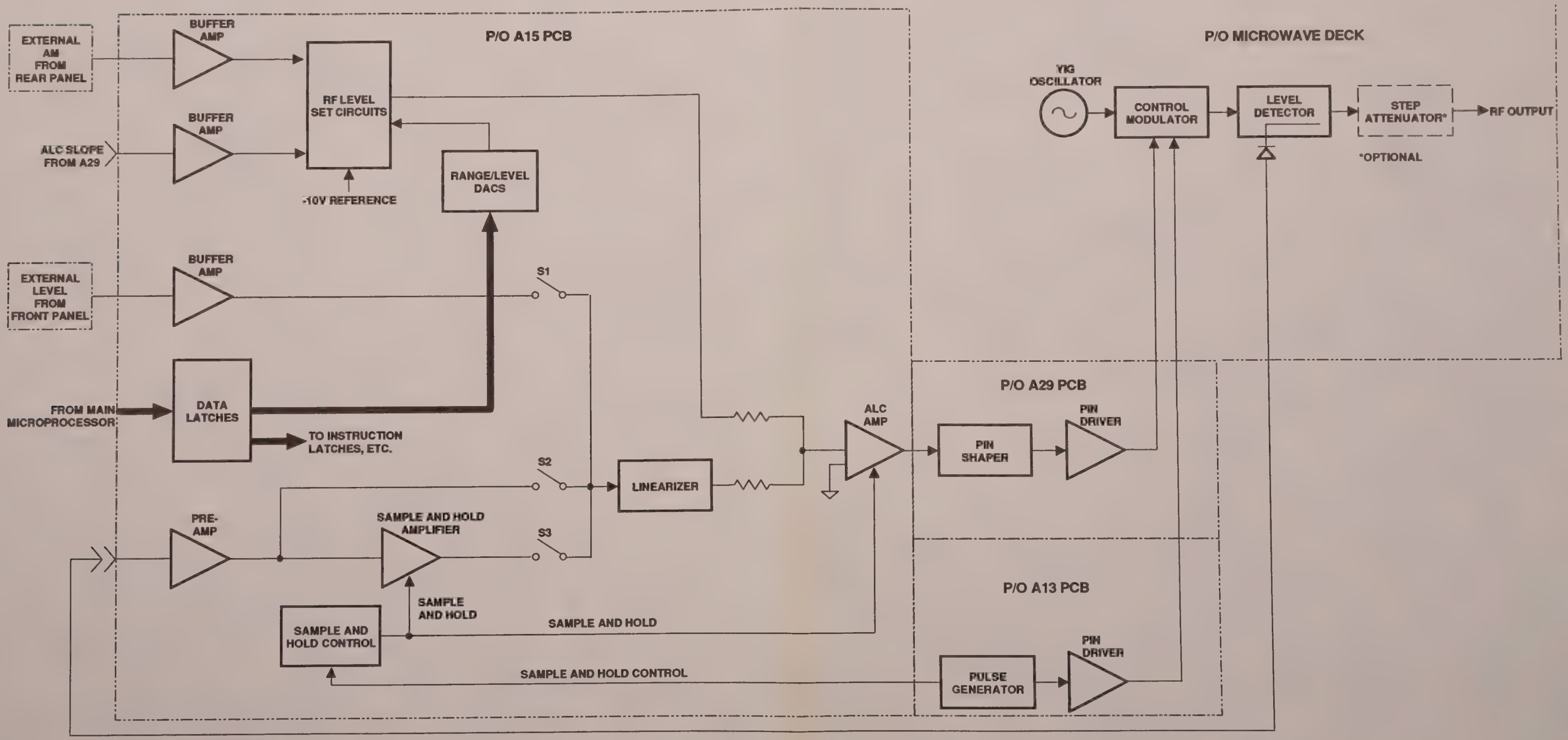

P/O A15 PCB
EXTERNAL AM FROM REAR PANEL
BUFFER AMP
BUFFER AMP
ALC SLOPE FROM A29
RF LEVEL SET CIRCUITS
-10V REFERENCE
RANGE/LEVEL DACS
EXTERNAL LEVEL FROM FRONT PANEL
BUFFER AMP
S1
FROM MAIN MICROPROCESSOR
DATA LATCHES
TO INSTRUCTION LATCHES, ETC.
S2
LINEARIZER
ALC AMP
PRE-AMP
SAMPLE AND HOLD AMPLIFIER
S3
SAMPLE AND HOLD
SAMPLE AND HOLD CONTROL
SAMPLE AND HOLD
SAMPLE AND HOLD CONTROL
P/O MICROWAVE DECK
YIG OSCILLATOR
CONTROL MODULATOR
LEVEL DETECTOR
STEP ATTENUATOR*
RF OUTPUT
*OPTIONAL
P/O A29 PCB
PIN SHAPER
PIN DRIVER
P/O A13 PCB
PULSE GENERATOR
PIN DRIVER

Figure 6B-3. Overall Block Diagram of ALC and Modulation Circuits

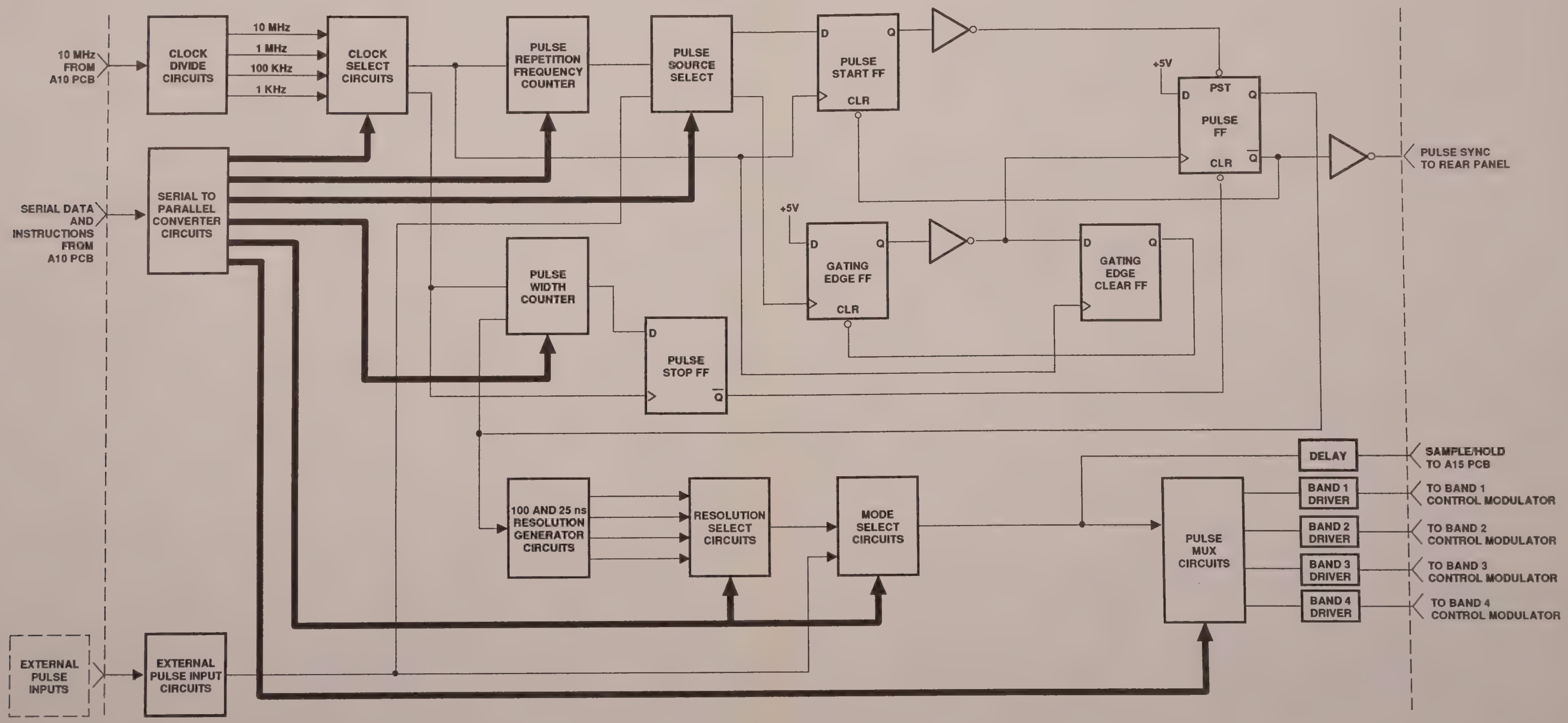

10 MHz FROM A10 PCB
CLOCK DIVIDE CIRCUITS
10 MHz
1 MHz
100 KHz
1 KHz
CLOCK SELECT CIRCUITS
PULSE REPETITION FREQUENCY COUNTER
PULSE SOURCE SELECT
D
Q
PULSE START FF
CLR
+5V
D
PST
Q
PULSE FF
CLR
Q̄
PULSE SYNC TO REAR PANEL
SERIAL DATA AND INSTRUCTIONS FROM A10 PCB
SERIAL TO PARALLEL CONVERTER CIRCUITS
+5V
D
Q
GATING EDGE FF
CLR
D
Q
GATING EDGE CLEAR FF
PULSE WIDTH COUNTER
D
PULSE STOP FF
Q̄
DELAY
SAMPLE/HOLD TO A15 PCB
100 AND 25 ns RESOLUTION GENERATOR CIRCUITS
RESOLUTION SELECT CIRCUITS
MODE SELECT CIRCUITS
PULSE MUX CIRCUITS
BAND 1 DRIVER
TO BAND 1 CONTROL MODULATOR
BAND 2 DRIVER
TO BAND 2 CONTROL MODULATOR
BAND 3 DRIVER
TO BAND 3 CONTROL MODULATOR
BAND 4 DRIVER
TO BAND 4 CONTROL MODULATOR
EXTERNAL PULSE INPUTS
EXTERNAL PULSE INPUT CIRCUITS

Figure 6B-4. Overall Block Diagram of Pulse Generator Circuits

4-10
12-10
12-11

6C-TROUBLESHOOTING

6C-1 OVERALL TROUBLESHOOTING

The 67XXA Synthesizer contains firmware that generates hidden-key routines and error codes that aid in troubleshooting instrument failures to the replaceable subassembly level. Subsection 6C provides a tabular listing of the hidden-key routines used for troubleshooting and the error codes along with their possible causes. Troubleshooting procedures for faults that do not produce error codes are also provided.

NOTE

> It is recommended that you upgrade your instrument's operating firmware to the latest available version. Although the error codes and hidden-key routines cited herein may have been implemented in earlier versions of firmware, newer firmware versions contain upgraded testing and calibration techniques that will maximize the performance of your instrument. Contact WILTRON Customer Service at (408) 778-2000 for further details.

6C-2 HIDDEN-KEY ROUTINES

The <Shift> TRIGGER key in conjunction with a 3 digit code implements the 67XXA's hidden-key routines. These routines are used to in calibration and troubleshooting. Table 6C-1 provides descriptions of the routines useful in troubleshooting. Once a hidden-key routine has been activated, the keys used (except for the DATA ENTRY keypad) have different functions than are indicated by the 67XXA's front panel markings.

Use caution when entering <Shift> TRIGGER codes during calibration or troubleshooting procedures. Entry of an incorrect <Shift> TRIGGER code may damage or erase stored calibration data.

6C-3 ERROR CODES

During normal 67XXA operation, self test runs automatically as part of the instrument turn-on process. If there is a failure during self test, an error code is generated and displayed in the FREQUENCY LCD display area. This alerts the operator to the failure and aids in troubleshooting the failure to a replaceable subassembly.

In addition, self test of specific subsystems or subassemblies may be invoked at anytime by using the appropriate hidden-key routine as described in paragraph 6C-2 and Table 6C-1.

Table 6C-3 provides a summary listing of the error codes along with descriptions and probable causes. This table makes reference to additional procedures located in the various subsystem sections of the manual. These additional procedures provide more detailed trouble isolation techniques.

6C-4 MASTER RESET FUNCTION

This function causes the non-volatile ram on the A23 PCB to be erased. In addition to being used to overwrite the non-volatile RAM and to cancel the <Shift> TRIGGER 004 function, it is used as a trouble shooting diagnostic aid. To perform a master reset, proceed as follows:

1. With the 67XXA in STANDBY, press and hold the RF ON/RF OFF key.
2. Press the STANDBY/ON key to turn the instrument on. After the displays blank and the self test has started, release the RF ON/RF OFF key.

NOTE:

> This procedure overwrites all information stored in the non-volatile RAM, including the 9 stored front panel setups with their default values. Whenever a master reset is performed, an E8-10 error will occur.

6C-5 TROUBLESHOOTING FAULTS THAT DO NOT PRODUCE ERROR CODES

Since the 67XXA Synthesizer must run self test to generate error codes, faults that cause the instrument to be non-operational do not produce error codes. These faults generally are: failure to power up properly, unexpected shutdown, and front panel lock up. Table 6C-2 provides troubleshooting procedures for these types of failures along with their most probable causes.

Table 6C-1. Descriptions of Hidden-Key Routines Useful in Maintenance/Troubleshooting (1 of 6)

<Shift> TRIGGER Code	Function
000	Enables the security function that turns off the FREQUENCY and MODULATION displays. It is disabled by a reset.
001	Enables the security function that turns off all of the front panel displays. It is disabled with a reset.
002	Enables the external high-resolution mode. It is turned off by a reset or <Shift> TRIGGER 003.
003	Disables the external high-resolution mode.
004	Makes the non-volatile RAM act like standard RAM on POWER OFF/ON. This function is disabled with a master reset (para 6C-4).
008	Enables the entry or display of the instrument serial number in the FREQUENCY display window.
009	Enables the display of the current firmware version number in the FREQUENCYdisplay window. <Shift> exits this function.
010	Enables the display of the Reference Loop frequency in the FREQUENCY display window and the tuning voltage in the LEVEL display window.
011	Enables direct control of the Fine Loop. The frequency is displayed in the FREQUENCY display window and the tuning voltage is displayed in the LEVEL display window. Changes to the Fine Loop frequency are made with DATA ENTRY keypad inputs.
012	Enables direct control of the Coarse Loop. The frequency is displayed in the FREQUENCY display window and the tuning voltage is displayed in the LEVEL display window. Changes to the Coarse Loop frequency are made with DATA ENTRY keypad inputs.
019	Executes the display test that is part of self test. The test turns on all the LEDs and all segments of the LCD displays continuously. Unit must be turned off to terminate this test.
020	Executes the Microprocessor test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
021	Executes the A17 DVM test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
022	Executes the power supply and A22 voltage regulator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
023	Executes the A8 serial I/O test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
024	Executes the A17 ramp generator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
025	Executes the A13 pulse generator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
026	Executes the A16 FM PCB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
027	Executes the A17 Analog Instruction PCB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
028	Executes the A15 ALC PCB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
029	Executes the A15 leveling loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
030	Executes the A15 ALC test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.

Table 6C-1. Descriptions of Hidden-Key Routines Useful in Maintenance/Troubleshooting (2 of 6)

<Shift> TRIGGER Code	Function
031	Executes the A5 reference oscillator test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
032	Executes the A9, A11 Fine Loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
033	Executes the A3, A4, A6 Coarse Loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
034	Executes the A12, A16 YIG Loop test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
035	Executes the A24 GPIB test that is part of self test. Displays any failures as error codes in the FREQUENCY display window and outputs a pass/fail message thru the GPIB.
080	Unlocks the 67XXA. Mainly used for unlocked FM mode where it is possible to get up to a 25 MHz deviation. It is disabled by reset or <Shift> TRIGGER 081.
081	Disables hidden-key routine 080. Resets the 67XXA to normal locking.
089	Enables access to hidden-key routines that have <Shift> TRIGGER codes from 300 to 599. These routines are used for calibration or to check out the DACs to be calibrated. (Refer to Section 3, Table 3-3 for a listing these hidden-key routines.)
599	Enables access to hidden-key routines that have <Shift> TRIGGER codes above 600. These routines are used for troubleshooting.
600	Tests the front panel LEDs.
603	Sets the A17 ramp generator to the end of the ramp (10 Volts).
604	Sets the A17 ramp generator to the beginning of the ramp (0 Volts)
612	Sets the A17 DVM scale to 2. This makes the voltage range -20 to +20 Volts.
613	Disables hidden-key routine 612.
614	Sets the A17 DVM scale to 10. This makes the voltage range -100 to +100 Volts.
615	Disables hidden-key routine 614.
616	Sets A17 power meter switch 1 to closed.
617	Sets A17 power meter switch 1 to open.
618	Sets A17 power meter switch 2 to closed.
619	Sets A17 power meter switch 2 to open.
620	Sets all A17 power meter gain switches to open.
621	Sets A17 power meter gain = 1.
622	Sets A17 power meter gain = 10.
623	Sets A17 power meter gain = 100.
624	Sets A17 power meter gain = 1000.
625	Sets A17 power meter gain = 10000.
626	Switches on the A16 fast loop enable.
626	Switches off the A16 fast loop enable.

Table 6C-1. Descriptions of Hidden-Key Routines Useful in Maintenance/Troubleshooting (3 of 6)

<Shift> TRIGGER Code	Function
628	Sets FM to DC coupled on the A16 PCB.
629	Sets FM to AC coupled on the A16 PCB.
630	Switches on the FM 30 Hz high-pass filter on the A16 PCB.
631	Switches off the FM 30 Hz high-pass filter on the A16 PCB.
632	Switches on the FM ATTEN B X10 on the A16 PCB.
633	Switches off the FM ATTEN B X10 on the A16 PCB.
634	Switches on the FM ATTEN A X10 on the A16 PCB.
635	Switches off the FM ATTEN A X10 on the A16 PCB.
636	Switches on FM enable on the A16 PCB.
637	Switches off FM enable on the A16 PCB.
638	Switches on FM sweep enable on the A16 PCB.
639	Switches off FM sweep enable on the A16 PCB.
640	Switches on YIG loop enable on the A16 PCB.
641	Switches off YIG loop enable on the A16 PCB.
642	Selects +10 V reference for the A17 Tuning DAC.
643	Selects -10 V reference for the A17 Tuning DAC.
644	Set A17 Tuning gain to 4.
645	Set A17 Tuning gain to 1.
646	Set A17 gain 0 width path.
647	Set A17 gain 1 width path.
648	Set A17 gain 4 width path.
649	Disables the A17 ramp Integrator.
650	Enables the A17 ramp integrator.
651	Selects A17 sweep ramp of <1 sec.
652	Selects A17 sweep ramp of >1 sec.
656	Clears the A17 dwell strobe.
657	Enables the A17 dwell strobe.
658	Disables the A17 dwell strobe.
659	Disable all the YIG-tuned oscillators.
660	Enable the CS band YIG-tuned oscillator.
661	Enable the X band YIG-tuned oscillator.
662	Enable the Ku band YIG-tuned oscillator.
663	Enable the K band YIG-tuned oscillator.

Table 6C-1. Descriptions of Hidden-Key Routines Useful in Maintenance/Troubleshooting (4 of 6)

<Shift> TRIGGER Code	Function
670	Sets A17 power meter amplifier A to gain of 1.
671	Sets A17 power meter amplifier A to gain of 10.
672	Sets A17 power meter amplifier A to gain of 100.
673	Sets A17 power meter amplifier B to gain of 1.
674	Sets A17 power meter amplifier B to gain of 10.
675	Sets A17 power meter amplifier B to gain of 100.
681	FM input path test.
682	AM input path test.
686	Test the Digital Horizontal Output DAC.
687	Display the rear panel switch settings in the FREQUENCY display window.
689	Enable access to and display of the Memory RAM.
690	Enable the 20 Volt scale in the external DVM.
691	Enable the 100 Volt scale in the external DVM.
692	Test EEPROM U27.
693	Test EEPROM U28.
694	Enable access to and display of EEPROM data.
695	Copy EEPROM U27 to U28.
697	Display number of errors in EEPROM test.
699	Copy EEPROM U28 to U27.
703	Enable control of the A17 analog ramp and set it to the end.
704	Enable control of the A17 analog ramp and set it to the beginning.
710	Displays the tuning range of the Fine Loop.
711	Finds the locking time for the Fine Loop.
712	Checks the Fine Loop linearity.
720	Displays the tuning range of the Coarse Loop.
721	Finds the locking time for the Coarse Loop.
722	Checks the Coarse Loop linearity.
730	Displays the tuning range of the Reference oscillator.
732	Display the tuning range of the YIG Loop for the current band.
733	Finds the locking time for the YIG Loop for the current band.
734	Checks the YIG Loop linearity for the current band.
760	Checks the A17 DVM linearity.
761	Turns on the external DVM.

Table 6C-1. Descriptions of Hidden-Key Routines Useful in Maintenance/Troubleshooting (5 of 6)

<Shift> TRIGGER Code	Function
762	Turns on the internal DVM.
764	Activates power meter test with fixed gain.
765	Deactivates the power meter test with fixed gain.
766	Disables power meter temperature compensation.
767	Enables power meter temperature compensation.
768	Disables power meter offset compensation.
769	Enables power meter offset compensation.
770	Disable zero FM autocalibration.
771	Enable zero FM autocalibration.
772	Remove the CW filter from the YIG Loop.
773	Place the CW filter in the YIG Loop.
776	Execute the zero FM routine. Reduce the FM error.
778	Zero out the frequency dynamic calibration.
791	This routine will sweep the A17 Tuning DAC in 100 step increments.
792	This routine will sweep the A17 Sweep Width DAC in 100 step increments.
793	This routine will sweep the A17 Tuning and Sweep Width DACs at the same time.
794	This routine will sweep the A17 Linearizer DAC.
795	This routine will sweep the A17 Breakpoint DAC.
796	This roiutine will sweep the A17 Sweep Time DAC.
797	This routine will sweep the A17 Switchpoint DAC.
798	Exercise the analog ramp in the open loop.
820	Causes a pause the external leveling calibration.
821	This routine is used to stop the analog sweep at each dwell point. The microprocessor will stop the sweep just before it locks. Pressing <Shift> allows the sweep to continue to the next dwell point.
904	Disables the line/external trigger interrupt.
905	Enables the line/external trigger interrupt.
906	Disables the dwell interrupt.
907	Enables the dwell interrupt.
908	Disables the timer 2 interrupt.
909	Enables the timer 2 interrupt.
910	Disables the timer 1 interrupt.
911	Enables the timer 1 interrupt.
912	Disable the GPIB interrupt.
913	Enable the GPIB interrupt.

Table 6C-1. Descriptions of Hidden-Key Routines Useful in Maintenance/Troubleshooting (6 of 6)

<Shift> TRIGGER Code	Function
914	Disable the fast frequency change interrupt.
915	Enable the fast frequency change interrupt.
916	Disable the front panel interrupt.
917	Enable the front panel interrupt.
918	Disable the housekeeping interrupt.
919	Enable the housekeeping interrupt.

Table 6C-2. Troubleshooting Turn On, Unusual Shutdown, and Locked Up Front Panel Problems (1 of 2)

Trouble Indication	Troubleshooting Procedure
Synthesizer does not-power up, **STANDBY** lite OFF.	Check both line fuses on rear panel. • If the line fuses are good, check A22TP11 for +24V. • If the +24V is present, check the A28J1 connection to the front panel casting. If this connection is good, then there is an open in the cabling between the front panel casting and the A1 and A2 PCBs. • If there is no +24V present at A22TP11, disconnect A28J3 and A28J1. If the +24V appears, there is a short circuit in either the front panel casting PCBs or the 10 MHz crystal oscillator. • If the +24V does not appear, the problem is with A22VR1, A52T1, or A28CR6-9.
Synthesizer does not power up, **STANDBY** lite ON.	When the **LINE** key is pressed, the **STANDBY** lite should go off and the **ON** lite should illuminate. • If **STANDBY** goes off and the **ON** lite remains off, it indicates either that the **LINE** switch is defective or that there is a short circuit on the +24V line following the **LINE** switch. • If the **STANDBY** lite goes off and the **ON** lite illuminates as normal, you should hear a click. This click means the A28K1 relay has energized. If A28K1 does not energize, but the fan operates, then A28K1 is defective. If the fan does not operate, the cabling from the front panel casting via A28J2 is most likely open.
Front panel LCDs and LEDs flash on and off when **LINE** is switched to **ON**.	Indicates one of the A25 outputs is shorted to ground. • Perform master reset (para 6C-4). • Refer to paragraph 6N-7 for additional power supply assemblies troubleshooting procedures.

Table 6C-2. Troubleshooting Turn On, Unusual Shutdown, and Locked Up Front Panel Problems (2 of 2)

Trouble Indication	Troubleshooting Procedure
Synthesizer operates for some time, then shuts down (**ON** indicator is on). After a short time, synthesizer resumes normal operation.	Indicates the 67XXA synthesizer has reached an excessive operating temperature. • If fan is still operating, clean air filter. • If fan is not operating, the trouble could be A22VR1, the fan, or the fan circuitry. Refer to paragraph 6N-7 for additional troubleshooting procedures.
Front Panel Hangs Up	During normal operation when the synthesizer is turned on, the front panel LCD displays and LEDs will light in a random pattern for a few seconds and then blank while self test is being performed. Upon completion of self test, the front panel will display the set-up that the synthesizer had when last powered down. If the LCD numeric displays and the indicator LEDs never change from their initial random pattern and/or if front panel control is lost, a problem in either the Digital Control subsystem or the Operator I/O subsystem is indicated. Troubleshoot as follows: During power up, monitor A28J1-3 and A28J1-4 (Mother board connector that connects to the front panel casting) with an oscilloscope. You should observe a TTL serial data signal on pin 3 and a TTL 400 kHz clock signal on pin 4 at intervals indicating that the front panel is being written to by the A8 Serial I/O. • Perform master reset (para 6C-4). • If the data and clock signals are observed at A28J1 pins 3 and 4, then the malfunction is most likely in the Front Panel A1 and A2 PCBs. Refer to paragraph 6D-7 for front panel assemblies troubleshooting procedures. • If the data and clock signal are ***not*** observed at A28J1 pins 3 and 4, the problem lies within the Digital Control Subsystem. Refer to paragraph 6E-7 for digital control assemblies troubleshooting procedures.

Table 6C-3. Summary of Error Codes with Probable Causes (1 of 9)

Error Code	Description	Remarks/Possible Problem Area
E0-0	The microprocessor is unable to perform a self-test. This can be caused by either the DVM or the ±15V(G) supplies. This is a fatal error, which means that normal operation is curtailed until the error is corrected.	Refer to Section 6N Power Supply Assemblies for troubleshooting procedures.
E0-1	The A17 Board is missing, or +10V Reference in A17 or A15 failed.	
	Coarse Loop Tests **NOTE** The Reference Loop must be operating.	Refer to paragraph 6H-6 for detailed Coarse Loop troubleshooting procedures.
E4-10	Phase-Lock Error — This test checks the A6 PCB for phase detector output. If this test passes, then the E4-13 test is run. If this test fails, then the E4-11 and E4-12 tests are used to narrow the problem area.	A3, A4, or A6 PCBs.
E4-11	Phase-Lock Negative Error — The 10 MHz reference for the Coarse Loop Subsystem is missing.	A6 PCB Input Buffer or A10 PCB Reference Buffer.
E4-12	Phase-Lock Positive Error — The A6 Coarse Loop Divider PCB is not receiving a signal from the A3 Coarse Loop Mixer PCB.	A3 and A4 PCBs.
E4-13	VCO Tuning Voltage Error — The VCO tuning voltage is out of range. The instrument may operate normally; however, it needs to be recalibrated.	If the voltage value reveals that the sweep is at the end of its range opposite from where it should be, the probable cause is the A4 PCB Tuning Amplifier.
	Reference Loop Tests **NOTE** The E5-series tests take precedence over the E4-, E9-, and E12-series tests. If there is no output from the A5 PCB (via the A10 PCB) the E4-, E9-, and E12-series tests are bypassed until the A5 PCB error is corrected.	Refer to paragraph 6G-6 for detailed Reference Loop troubleshooting procedures.
E5-10	Phase-Lock Error — Test checks whether the A5 Reference Oscillator is locked. If unlocked, the E5-11 and E5-12 tests are run. If locked, they are bypassed.	

Table 6C-3. Summary of Error Codes with Probable Causes (2 of 9)

Error Code	Description	Remarks/Possible Problem Area
E5-11	Phase-Lock Negative Error	The A7 Reference Divider PCB.
E5-12	Phase-Lock Positive Error	The A7 Reference Divider PCB is not receiving the 500 MHz signal from the A5 PCB.
E5-13	VCO Tuning Voltage Error	The alignment of the VCO tuning voltage is marginal and requires recalibration.
	A8 Serial I/O Test	
E8-10	Serial I/O Not Responding — Failure indicates that the A8 Serial I/O PCB is not receiving information from the front panel.	Refer to paragraph 6E-7 for detailed Serial I/O troubleshooting procedures.
	Fine Loop Tests **NOTE** The Reference Loop must be operating but not locked for the following tests. If there is an E5 error code, then the E9-series tests are run. If the E9-series tests fail, only the E5 error code will be displayed.	Refer to paragraph 6I-7 for detailed Fine Loop troubleshooting procedures.
E9-10	Phase-Lock Error — Tests whether the A9 Fine Loop Oscillator is locked. If unlocked, the E9-11 and E9-12 tests are run. If locked, they are bypassed.	
E9-11	Phase-Lock Negative Error	The A11 Reference Divider PCB is not receiving the Fine Loop signal from the A9 PCB.
E9-12	Phase-Lock Positive Error	The 10 MHz reference signal is not being received by the A11 Reference Divider PCB.
E9-13	VCO Tuning Voltage Error — The VCO tuning voltage is out of range. The instrument may operate properly; however, it should be calibrated.	If the voltage value reveals that the sweep is at the end of its range opposite from where it should be, the probable cause is the A9 PCB Tuning Amplifier.

Table 6C-3. Summary of Error Codes and Probable Causes (3 0f 9)

Error Code	Description	Remarks/Possible Problem Area
	A12 YIG Loop Tests **NOTE** The E4-, E5-, and E9-series tests must have been successfully completed before these tests will be run. If any of the E4-, E5-, or E9-series tests fail, the E12-series tests are bypassed.	Refer to paragraph 6J-7 for detailed YIG Loop troubleshooting procedures.
E12-10	Phase Lock Error — The YIG Loop will not phase lock in any band. If completed successfully, the E12-11 and E12-12 tests are bypassed. If only one oscillator is not locking, the FM-path error code for that oscillator is displayed.	A12, A16, A30 and/or A31 PCBs
E12-11	Phase-Lock Negative Error	The reference signal from the A9 PCB is not being received.
E12-12	Phase-Lock Positive Error	No RF is being received from the A30 Sampler/IF PCB.
	A13 Pulse Generator test	Refer to paragraph 6M-3 for detailed Pulse Generator troubleshooting procedures.
E13-10	Pulse Generator Error	A13 Pulse Generator PCB.
	A15 ALC tests	Refer to paragraph 6M-3 for detailed ALC troubleshooting procedures.
E15-10	UNLEVELED-Indicator-On Error — The front panel UNLEVELED indicator is always on.	A15U42-44
E15-11	UNLEVELED-Indicator-Off Error — The front panel UNLEVELED indicator will not come on.	A15U12, U40, or U42-44
E15-13	Phase Error, AM Peak Detector — The AM Peak Detector is inoperative.	A15U11, U13, or U15
E15-14	Phase Error,AM Trough Detector — Failure indicates that the AM Trough Detector is inoperative.	A15U11, U13, or U15
E15-15	–10V Reference Error	The A15 PCB –10V reference supply is inoperative: A15VR1, A15U14

Table 6C-3. Summary of Error Codes with Probable Causes (4 of 9)

Error Code	Description	Remarks/Possible Problem Area
E15-16	+10V Ref Error	The A15 PCB +10V reference supply is inoperative: A15VR1, A15U14
E15-20	Unleveled Error, Full Band — The RF output is unleveled (maximum output) across the entire frequency range. (If only one band were unleveled, one of the E18- thru E21-series error codes would be shown.)	
E15-21	No RF Error, Full Band — No RF output is present across the entire frequency range. (If only one band were unleveled, one of the E18- thru E21-series error codes would be shown.)	
E15-22	Slope DAC Error	Slope DAC is inoperative: A15U8, A15U9
E15-23	Detector Path Error, Band 0 CW	Either the Downconverter or the band 0 Preamplifier on the A15 PCB is defective.
E15-24	Detector Path Error, Band 1-4 CW	Either the Band 1-4 Level Detector or Band 1-4 Preamplifier on the A15 PCB is defective.
E15-25	Detector Path Error, Band 0 Sample/Hold — This test is bypassed if the E15-23 test passes.	This detector path, which is used during pulse operations, is defective.
E15-26	Detector Path Error, Band 1-4 Sample/Hold — This test is bypassed if the E15-24 test passes.	This detector path, which is used during pulse operations, is defective.
E15-30	Band 0 Pulse Error — This test is bypassed if the E13-10 test passes.	Indicates that the A13 PCB pulse driver for Band 1, Band 1 Control Modulator, or A15 Sample/Hold circuit is defective.
E15-31	Band 1-4 Pulse Error — This test is bypassed if the E13-10 test passes.	The A13 PCB pulse drivers, or the A15 PCB Sample/Hold circuit is defective.
E15-40	Voltage Level reference error.	
	A16 FM tests	Refer to paragraph 6J-7 for detailed FM troubleshooting procedures.
E16-10	FM Ø Error	The FM peak detector on A16 is inoperative: A16U28
E16-11	Phase Mod Ø Error	The Phase Modulation Peak Detector on the A16 PCB is inoperative: A16U30

Table 6C-3. Summay of Error Codes with Probable Causes (5 of 9)

Error Code	Description	Remarks/Possible Problem Area
E16-12	YIG Loop Ø Error	The loop amplifier for the YIG loop is inoperative.
E16-13	Sweep Path Error, YIG FM	The 50 MHz sweep path is inoperative.
	A17 Analog Instruction Tests	Refer to paragraph 6K-15 for detailed Analog Instruction troubleshooting procedures.
E17-10	DVM Measurement Error, 0 Volts — The DVM is inoperative. All other tests are bypassed. This is a fatal error; the instrument is inoperative.	
E17-11	DVM Measurement Error, +10 Volt Reference	The 10V reference for the A17 PCB is defective.
E17-12	DVM Measurement Error, +20 Volt Range	The 20V range of the DVM is inoperative.
E17-13	DVM Measurement Error, 100 Volt Range	The 100V range of the DVM is inoperative.
E17-20	Tune DAC 0V	The Tune DAC is not operating properly.
E17-21	Tune DAC +10V	The Tune DAC –10V reference supply or the Tune DAC itself is defective.
E17-22	DVM Error, Tune DAC –10V	The Tune DAC +10V reference supply or Tune DAC is defective.
E17-23	DVM Error, Tune DAC Sweep	Linearity problem in the Tune DAC.
E17-24	DVM Error, Tune DAC Gain= 4	The switch for gain=4 is defective: A17U41A.
E17-30	Ramp Generator Error	The integrator for the ramp generator and its associated circuitry is not operating properly.
E17-31	Sweep Time Error, Sweep Time DAC	The DAC that controls the sweep time is out of its specified limits.
E17-32	Retrace Time Error, Sweep Time DAC	Error in retrace timing of the ramp.
E17-33	Range Error, Sweep Time Circuit	Error in the >1 second sweep-time circuitry.
E17-40	Sweep Width DAC Error, 0V	Sweep Width DAC error at maximum attenuation.
E17-41	Sweep Width DAC Error, Full-Scale, +10V	Sweep Width DAC error at full scale.

Table 6C-3. Summary of Error Codes with Probable Causes (6 of 9)

Error Code	Description	Remarks/Possible Problem Area
E17-42	Sweep Width DAC Error. –10V	
E17-43	Sweep Width DAC Error, 1% Steps	Sweep Width DAC linearity error.
E17-44	Sweep Width DAC Error, Gain 4	The Gain=4 switch is defective: A17U36.
E17-50	Linearizer Slope DAC 0 Error	Linearizer DAC is defective.
E17-51	Linearizer Slope DAC 100 % Error	Linearizer DAC is defective.
E17-52	Linearizer Slope DAC 0 % Error	Linearizer DAC is defective.
E17-53	Linearizer Breakpoint DAC 50% Error	Breakpoint DAC is defective.
E17-60	Power Meter Error	Power meter circuit is defective.
	RF tests **NOTE** The following error codes indicate a problem on the RF microwave deck. They may not be applicable to all 67XXA models because of different RF microwave deck configurations. Refer to Table 6Q-2 for the RF microwave deck configuration by model number. The first two digits of the error code indicate the number of the YIG Driver PCB (A18 thru A21) associated with the frequency band. The third digit is the frequency band number. The fourth digit is the type of test.	Refer to paragraph 6Q-6 for detailed RF troubleshooting procedures.
E18-01	Unleveled Error, Band 0	The downconverter output is unleveled. The Band 1 Control Modulator or modulator drive is the most probable cause.
E18-02	No RF Error, Band 0	Either the Downconverter is defective or there is no output from the A5 Reference Oscillator PCB to the Downconverter.
E18-03	FM Path Error, Band 0	The FM driver on A18 is defective.

Table 6C-3. Summary of Error Codes with Probable Cause (7 of 9)

Error Code	Description	Remarks/Possible Problem Area
E18-11	Unleveled Error, Band 1	The Band 1 Control Modulator or driver is defective.
E18-12	No RF Error, Band 1	The Band 1 Control Modulator or YIG-tuned oscillator is defective.
E18-13	FM Path Error, Band 1	The FM driver on A18 is defective.
E19-21	Unleveled Error, Band 2	The Band 2 Control Modulator or driver is defective.
E19-22	No RF Error, Band 2	The Band 2 Control Modulator or YIG-tuned oscillator is defective.
E19-23	FM Path Error, Band 2	The FM driver on A19 is defective.
E20-31	Unleveled Error, Band 3	The Band 3 Control Modulator or driver is defective.
E20-32	No RF Error, Band 3	The Band 3 Control Modulator or YIG-tuned oscillator is defective.
E20-33	FM Path Error, Band 3	The FM driver on A20 is defective.
E21-41	Unleveled Error, Band 4	The Band 4 Control Modulator or driver is defective.
E21-42	No RF Error, Band 4	The Band 4 Control Modulator or YIG-tuned oscillator is defective.
E21-43	FM Path Error, Band 4	The FM driver on A21 is defective.
E21-51	Unleveled Error, Band 5	The Band 3 Control Modulator or driver is defective.
E21-52	No RF Error, Band 5	The Band 3 Control Modulator, YIG-tuned oscillator, or ffrequency doubler/ amplifier is defective.
E21-53	FM Path Error, Band 5	The FM driver on A20 is defective.
	Power Supply/Regulator Tests	Refer to paragraph 6N-7 for detailed Power Supply and Regulator troubleshooting procedures.
E22-10	PS1 Error	A PS1 monitor problem which cannot be determined from the E22-21 thru -29 tests.
E22-11	PS2 Error	A PS2 monitor problem which cannot be determined from the E22-21 thru -29 tests.

Table 6C-3. Summary of Error Codes with Probable Causes (8 of 9)

Error Code	Description	Remarks/Possible Problem Area
E22-20	+9V LP Error	The 9V supply has no output to the 5V regulators in the phase lock circuitry.
E22-21	+24V Error	The supply is unregulated. If there is no output from this supply, the STANDBY lite will not illuminate and the instrument will not power up.
E22-22	+15V (G) Error	There is no output from this supply located on the A22 PCB.
E22-23	–18V Tuning Error	There is no output from this supply located on the A22 PCB.
E22-24	–43V Tuning Error	There is no output from this supply located on the A22 PCB.
E22-25	–15V LP Error	There is no output from this supply located on the A22 PCB.
E22-26	+15V LP Error	There is no output from this supply located on the A22 PCB.
E22-27	+15V FM Error	There is no output from this supply located on the A22 PCB.
E22-28	+15V (A) Error	There is no output from this supply located on the A22 PCB.
E22-29	–15V FM Error	There is no output from this supply located on the A22 PCB.
E22-30	–15V (A) Error	There is no output from this supply located on the A22 PCB.
E22-31	–15V (G) Error	Ther e is no output from this supply located on the A22 PCB.
	Microprocessor Tests	Refer to paragraph 6E-7 for detailed Microprocessor troubleshooting procedures.
E23-10	Non-volatile RAM for storing front panel setups has failed read-write testing.	Replace A23U25.
E23-11	Volatile RAM #1 has failed read-write test	Replace A23U26.
E23-12	Volatile RAM #2 has failed read-write test	Replace A23U29.
E23-14	Personality PROM Check-Sum Error	Replace A23U24.
E23-15	EPROM #1 Check-Sum Error	Replace A23U22 .

Table 6C-3. Summary of Error Codes with Probable Causes (9 0f 9)

Error Code	Description	Remarks/Possible Problem Area
E23-16	EPROM #2 Check-Sum Error	Replace A23U23.
E23-17	EEPROM Check-Sum Error	Error in the Band 0 level detector calibration table.
E23-18	EEPROM Check-Sum Error	Error in the Band 1-4 level detector calibration table.
E23-19	EEPROM Check-Sum Error	Error in the attenuator insertion loss table.
E23-20	Stored Setups Check-Sum Error	Perform master reset (para 6C-4).
E23-21	I/O Error — Indicates the I/O interrupt is inoperative.	Replace A23U8.
	A24 GPIB Tests	Refer to paragraph 6E-7 for detailed GPIB troubleshooting procedures.
E24-0	GPIB no response or A24 not installed	
E24-10	Check-Sum Error in the GPIB RAM	Replace A24U11.
E24-11	Check-Sum error in the PROM	Replace A24U10.
E24-12	GPIB Interface Error	The interface processor is inoperative. Replace A24U7.
	A29 Rear Panel Interface Tests	Refer to paragraph 6F-7 for detailed Rear Panel Interface troubleshooting procedures.
E29-10	V/GHz Offset DAC Error	The U15 V/GHz Offset DAC or Data Latches U8 or U9.
E29-11	V/GHz Slope Error	The U13 V/GHz Slope DAC or Data Latches U8 or U9.

6D – FRONT PANEL: A1 and A2 PCBs

6D-1 FRONT PANEL ASSEMBLIES: A1 AND A2 PCBS

This section contains service information for the front panel assemblies listed in Table 6D-1 below. Refer also to the general reference information in Sections 6A, 6B, and 6C. It is also helpful to have an understanding of the Digital Control circuitry (Section 6E), the A17 Analog Instruction DVM circuitry (Section 6K), and the ALC circuits (Section 6M).

Table 6D-1. Front Panel Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6D-2	6D-2
Block Diagram	Fig. 6D-1	6D-9
Troubleshooting	Tbl. 6D-2	6D-6
PCB LEVEL		
A1 Front Panel PCB		
General Circuit Description	Para. 6D-3	6D-2
Detailed Circuit Description	Para. 6D-5	6D-3
Block Diagram	Fig. 6D-1	6D-9
Troubleshooting	Tbl. 6D-2	6D-6
Parts Locator Diagram	Fig. 6D-4	6D-10
Schematic (Sheet 1 of 4)	Fig. 6D-3	6D-11
(Sheet 2 of 4)	"	6D-13
(Sheet 3 of 4)	"	6D-15
(Sheet 4 of 4)	"	6D-17
A2 Front Panel PCB		
General Circuit Description	Para. 6D-4	6D-2
Detailed Circuit Description	Para. 6D-6	6D-4
Block Diagram	Fig. 6D-1	6D-9
Troubleshooting	Tbl. 6D-2	6D-6
Parts Locator Diagram	Fig. 6D-6	6D-18
Schematic (Sheet 1 of 3)	Fig. 6D-5	6D-19
(Sheet 2 of 3)	"	6D-21
(Sheet 3 of 3)	"	6D-23

6D-2 FRONT PANEL ASSEMBLIES, OVERALL DESCRIPTION

The front panel assemblies consists of the A1 Front Panel PCB and the A2 Front Panel Control PCB. Both are shown clearly in the Parts Lists assembly photographs located in Section V–Parts Lists.

The front panel group provides the interface between the operator and the microprocessor (which controls the operating functions of the instrument). Also included in this group is a preamplifier for the External ALC function of the Leveling Loop.

A block diagram of the Front Panel Subsystem is shown in the first foldout, Figure 6D-1. Please refer to this figure for the following general description of the A1 and A2 PCBs.

The interface between the front panel PCBs and the rest of the instrument is via wire harnesses between the A28 Motherboard and three A2 PCB connectors: A2P1, A2P2, and A2P4. These connectors provide the following functions:

- A2P1 provides:
  (1) The serial I/O to the A8 Serial I/O PCB for communication to the microprocessor,
  (2) Front panel power supply connections, and
  (3) Keyboard data and microprocessor interrupt signals.
- A2P2 provides:
  (1) +24VG from the power switch to enable the instrument power on circuits, and
  (2) The DECREASE/INCREASE knob DC voltage output. This voltage is monitored by the DVM on the A17 Analog Instruction PCB.
- A2P4 supplies:
  The external leveling signal that goes to the A15 ALC PCB; it is preamplified on the A2 PCB.

The A1 and A2 PCBs are mounted in the front panel casting to prevent the internal RF sources and microprocessor bus signals from interfering with sensitive external equipment. The A1 PCB displays are liquid crystal displays (LCD's) with a 150 Hz (approximate) backplane signal. Other than the constantly active LCD backplane signal, the front panel is in a completely static state. It only becomes active when the instrument microprocessor writes to an LCD display or LED latch or when a key is pressed.

6D-3 A1 FRONT PANEL PCB, GENERAL DESCRIPTION

Refer primarily to the front panel block diagram, Figure 6D-1, for the following descriptions.

6D-3.1 Alpha-Numeric Displays (LCDs) and Display Digit Drivers

The 67XXA has three, 7-segment, numeric liquid crystal displays (LCDs).

- FREQUENCY
- MODULATION/TIME
- LEVEL

These LCDs show characters and numerals that inform you of the status of instrument operations and function parameters. Each digit of the LCD is arranged in a 7-segment configuration. The driver for each full-size digit on the LCDs receives 8-bit parallel data from the A2 Front Panel Control PCB data bus. Each 40-pin display digit driver package is capable of latching data and providing drive for as many as four LCD digits. The FREQUENCY display requires three driver packages while the MODULATION/TIME and LEVEL displays require only one driver each.

The MODULATION/TIME digit driver provides the backplane voltage for the other digit drivers.

In addition to the digit drivers controlling the LCD characters and numerals, there are distinct latches on the A2 PCB that control the messages displayed on the A1 PCB's LCDs (for example, the CW, MARKER, EXT REF, and LEVEL 1 messages) These latches also receive their control from the 8-bit data bus on the A2 PCB.

6D-3.2 Indicator LED's and Latch Drivers

Forty-seven of the fifty LED's on A1 Front Panel PCB receive their drive signals from the TTL data latches indicated on the A1 shematic (Figure 6D-3, sheet 2). These latches receive their control from the A2 PCB 8-bit data bus (signals **D0-D7**). They are controlled entirely by the A23 PCB Microprocessor via the A8 Serial I/O and A2 Front Panel Control PCBs. The RF UNLEVELED LED is the only one not directly under microprocessor control. It receives its control directly from the L RF UNLVLD line that originates on the A15 ALC PCB (section 6M, A15 schematic, sheet 5) and is routed via the A2 Front Panel Control PCB (A2 PCB schematic, sheet 1).

6D-3.3 Keyboard Matrix

All of the keyboard matrix keys are of a double-pole-single-throw (DPST) configuration (illustrated in the A1 PCB schematic notes, sheet 1). One pole supplies an X-axis signal and the other a Y-axis signal. The coordinate signals of these X and Y axes go to the A2 PCB where the appropriate X/Y coordinate button location is encoded and sent as an 8-bit serial data word to the A23 Microprocessor PCB (via the A8 Serial I/O PCB).

When the front panel STANDBY/LINE key is depressed (power on), it sends +24 volts to the A28K1 relay (on the A28 Motherboard PCB) to actuate the power supply circuits. This power-on circuitry is detailed on sheet 1 of the A28 schematic in Section 6P–Motherboard/Interconnects).

6D-4 A2 FRONT PANEL CONTROL PCB, GENERAL DESCRIPTION

Refer primarily to the front panel block diagram, Figure 6D-1, for the following description.

6D-4.1 Serial Input/Parallel Output

Data comes from the A8 Serial I/O PCB in a serial format. The front panel clock signal clocks a shift register that loads this serial data into a 16-bit latch. Eight bits are for the front panel 8-bit parallel data bus and eight bits are for addressing of the appropriate data latch on the A2 PCB or the LCD drivers on the A1 PCB. When the data has been loaded, the A8 PCB applies a strobe that loads the data into the latches.

When pressing a key, the Keyboard Decode logic determines the X and Y coordinates of the depressed key and sends an interrupt to the A23 Microprocessor PCB. The microprocessor then configures the A8 PCB to receive data from the front panel. The A8 PCB sends a clock signal to a shift register on the A2 PCB where the data is stored. The clock signal shifts the data out from the A2 PCB latches in serial format into another shift register on the A8 PCB. After completion of the serial I/O data transfer, the microprocessor reads the keycode from the shift register on the A8 PCB and takes appropriate action.

6D-4.2 DECREASE/INCREASE Knob Motor

The front panel DECREASE/INCREASE knob drives a dc motor producing a dc voltage that has a polarity set by the direction of rotation and is proportional in magnitude to the speed of rotation. This dc voltage goes to an amplifier on the A2 PCB having a gain of 10. The output of the amplifier goes as an analog voltage (**KNOB MON**) to the DVM multiplexer on the A17 Analog Instruction PCB. TheA23 PCB Microprocessor reads this voltage via the DVM, then determines the necessary amount and direction to change the currently open parameter.

Since the amplifier is dc coupled and of relatively high gain, the 67XXA has provision for zeroing the amplifier input voltage (via **KNOB AMP ZERO**). When in the zero mode, the A23 Microprocessor PCB reads the residual voltage at the DVM on the A17 PCB and stores this data. When the microprocessor reads a voltage resulting from movement of the knob, it subtracts this residual voltage data to determine the actual measurement value. This is especially important when the knob is turned very slowly, as it then produces extremely small voltages for the knob circuitry to work with. The ability of the knob circuitry to respond to such a wide range of operator control variances makes it very convenient to use the knob often for all function parameters with predictable control.

6D-4.3 External Detector Amplifier (EXT LEVEL BNC Input)

A differential receiver amplifier having a gain of 5 receives the analog input voltage from an external detector connected to the front panel EXT LEVEL BNC connector. (An external detector or power meter is often used instead of the 67XXA's internal detector to eliminate uncertainties caused by long cables or the insertion of an additional amplifier in the 67XXA's RF OUTPUT path.) The amplified signal goes to the A15 ALC PCB for further processing of output power level control. Since the external detector or power meter output voltage can be very low, provisions have been made for adjusting the offset balance of the amplifier (via potentiometer A2R15). Adjustment is made through a small hole in top of the front panel casting during calibration of the ALC circuits (see the procedures in section 3, Calibration and Adjustments). This adjustment access hole is covered by the instrument cover during normal operation.

6D-5 A1 FRONT PANEL PCB, DETAILED CIRCUIT DESCRIPTION

Refer primarily to the A1 PCB schematic set (Figure 6D-3, sheets 1 through 4) for the following descriptions.

6D-5.1 Line Switch and Power on Circuits

Refer to Figure 6D-3, sheet 1 and sheet 1 of the A28 schematic in section 6P. Whenever the 67XXA is physically connected to line voltage (ac mains), **+24V1** is present at A1P1-6. This voltage comes from the A22 Regulator Interface PCB.

- With the LINE switch in the STANDBY position, the **+24V1** goes only to the A1DS2 STANDBY LED.
- With the LINE switch in the ON position, **+24V1** becomes **+24VG** and goes to the ON LED (A1DS1) and to A1P1-5. This voltage at P1-5 energizes relay A28K1 (on the A28 Motherboard) which applies line voltage to the rectifiers located on the A28 Motherboard. This **+24VG** also supplies the **+24V1** required for the A5 Reference Oscillator, the +12V regulator (A25VR1) on the A25 Switching Power Supply PCB, and the V/GHz amplifier (A29U14) on the A29 Rear Panel Interface PCB.

6D-5.2 Front Panel Keys

Each key in the front panel keyboard matrix, with the exception of the SINGLE SWEEP key, is a DPST type switch (shown schematically in the Notes area of the A1 PCB schematic, sheet 1). Each time a key is pressed, **GND D** is sensed as an X and Y coordinate (**X0-X7** and **Y0-Y7**) by encoders A2U6 and U9 on the A2 Front Panel Control PCB (see sheet 1 of the A2 schematic). The parallel data output of the encoders is converted by A2U10 into a serial 8-bit byte format. Then, A2U11 sends an interrupt request (**KBD INT**, A2P1-7) to the A23 Microprocessor PCB. The microprocessor instructs the A8 Serial I/O PCB to obtain the available encoded data (known as the "keycode") from A2U10 which serially transmits the data word to the A23 Microprocessor PCB (**FRONT PANEL OUT**, A2P1-5).

The SINGLE SWEEP key uses two diodes, A2CR1 and CR2, rather than a pushbutton, to simulate a DPST switch with lines **X6** (a1P4-4) and **Y1**. The X and Y coordinates are then processed as previously described.

6D-5.3 LED Drivers

The 8-bit latches (A1U1-U6), shown on Sheet 2 of the A1 schematic, drive the LED indicators on the A1 Front Panel PCB. The latches receive their data via the 8-bit bus (**D0-7**) that comes from the serial/parallel conversion circuits on the A2 PCB. These latched LEDs, with the exception of the L RF UNLVLD LED, are entirely under software control. Q1 is the driver for the L RF UNLVLD LED and is controlled by the **L RF UNLVLD** signal from the A15 ALC board.

Note that U1 pin 19 (**KNOB AMP ZERO**, A1P1-4) does not drive an LED but supplies a logic signal for zeroing the DECREASE/INCREASE knob amplifier (A2U27) on the A2 Board.

6D-5.4 LCD Digit Drivers

The 4-digit LCD display drivers (A1U7-U12) are shown on sheets 3 and 4 of the A1 PCB schematic. The data inputs to each of these drivers are connected to the 8-bit bus (**D0-7**) that comes from the A2 Front Panel Control PCB. The **OSC** inputs (pin 36) of all drivers, except the U10 driver, are grounded. This disables the internal 19 kHz oscillator that provides the backplane signal (**BP**) required by the LCD's. U10's **OSC** pin is left floating; this enables its oscillator. This 19 kHz oscillator signal is internally divided by 128; the result is a 0 to 5 V square wave backplane signal at approximately 150 Hz (U10 pin 5). This signal goes directly to the backplane of the MODULATION/TIME display and to the inverting amplifier package U11. U11 buffers this backplane signal, reinverting its own output at pin 2 to obtain the proper polarity as inputs for its other five amplifiers, thereby providing the additional backplance signal drive capability for the other LCD digit drivers. The backplane signal, **BP**, also goes to the A2 Front Panel Control PCB via A1P3-6 to supply the backplane to the LCD message drivers located on the A2 Board.

6D-5.5 Digit Driver Strobe Signals

Each data latch requires a strobe signal. These strobe signals are decoded by A2U3, U7, and U8 (shown on sheet 1 of the A2 schematic). The **FP STRB** signal (A1P1-13) from the A8 Serial I/O board enables the appropriate strobe to latch data into their respective latches and display drivers.

6D-6 A2 FRONT PANEL CONTROL PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the A2 PCB schematic set (Figure 6D-5, sheets 1 through 3) for the following descriptions.

6D-6.1 Serial Input

Refer to sheet 1 of the A2 schematic. The serial data signal (**FP DATA**, A2P1-1) and clock signal (**FP CLK**, A2P1-5) go to U30, a Schmitt-trigger inverter that improves each signal's rise time. The rise time of these signals is severely degraded by the filtercons (filter connectors) mounted in the front panel casting. The clock signal goes to shift registers A2U1 and U2 to clock the serial input bits of each 16-bit word into the registers. U1 receives 8 bits of data for the data latches and LCD digit drivers; U2 receives 5 bits of address data for the latches.

Once the serial data has been shifted into the two registers, the **FP STRB** signal (A2P1-13) goes low to enable a low output from one of the three 3-to-8 decoders (A2U3, U7, or U8). The destination latch of the strobe elsewhere on the A1 or A2 PCB will then latch the available data on the internal 8-bit bus (**D0-7**) into its registers. After the strobe signal, further data bus changes will not affect data that has already been latched into the A1 or A2 latches.

Six inverting buffers in U4 and U5B invert the strobe signals going to latches that drive the LCD display messages.

6D-6.2 Keyboard Encoding

Each front panel key depression causes an interrupt on the A23 Microprocessor PCB. The keyboard matrix X and Y coordinate signals go to A2U6 and U9 encoders (on sheet 1 of the A2 schematic). These encoders perform the opposite function of the 3-to-8 decoders used for address decoding. When any of the inputs to the encoder goes low (to **GND D** when a key is depressed), it sets the Group Select (**GS**) output on U6 or U9 pin 14 low. This indicates that the pin 6, 7 and 9 outputs of U6 or U9 will be in a binary format. The **GS** output goes to U5A pin 2, which forces its pin 1 output to go high, and thereby causes U11A pin 5 output to go high. This sends a keyboard interrupt signal (**KBD INT**) to the A23 PCB.

Upon receiving the interrupt, the microprocessor completes its present task, then sends the address **FP DATA** to enable A2U10 (via the A8 Serial I/O

PCB). The response time from the time the interrupt is sent until the microprocessor services the interrupt depends on the particular task that is being performed at the time the interrupt request is received. In CW mode, this time is about 4 ms. In step sweep or analog sweep modes, response time can be from about 4 ms to about 20 ms.

At the same time A2U10 pin 1 goes low to load data into its registers, U11A pin 1 clears the flipflop and U11A pin 5 goes low to clear the interrupt request. Then, the microprocessor instructs the A8 PCB to send a clock pulse train to the A2 PCB where it shifts data out of A2U10 and shifts it into the A8 PCB shift register for reading by the A23 Microprocessor PCB.

The keycode is again verified under software control to validify an actual key depression. Approximately 7 ms later, the A23 Microprocessor again loads the A2U10 shift register and reads the data a second time. If the keycode is a valid code, and if it is the same as was read during the first conversion, the processor executes the routines for this keycode.

A valid key depression is also ensured through hardware constraints. The 6-bit keycode (A2U10 inputs **B-G**) is bracketed by the two **GS** bits from A2U6 and U9 pins 14 (A2U10 inputs **A** and **H**). Also, both the X and Y coordinates must be activated by the DPST switch configuration in order for an interrupt to be sent. If only one pole of the DPST key switch is grounded to **GND D**, it will not send an interrupt to the processor.

6D-6.3 Display Message Data Latches

A2U12 thru U25, shown on sheets 2 and 3 of the A2 schematic, are 4-bit latches/drivers for the LCDs. They operate in the same manner as a 74LS374 data latch except that their outputs always have a 50 Hz square wave imposed on them. This is due to the backplane signal, **BP**, on pin 2, the **DF** input to each of these latches. A high on the **DF** input will cause the output to be *180 degrees out of phase* with the backplance signal; a low on the input will cause the output to be *in phase* with the backplane signal.

Note that pairs of these latches are tied to a common strobe line. One latch receives the upper 4 bits and the other the lower 4 bits of each 8-bit parallel word on data bus lines **D0-D7**. Transition of the strobe line signals from low to high latches the data into the latches.

6D-6.4 Knob Amplifier

The front panel DECREASE/INCREASE knob motor, mounted on the front panel subplate is a DC motor. It's output varies in amplitude with the speed of the motor; the polarity of its output is determined by the direction of rotation. Its output voltage, across **KNOB MOTOR INPUT** and **REF**, goes via A2U26 analog switch to A2U27. A2CR1 and CR2 clamp the output of the motor to approximately 10.7 volts to prevent damage to U26 analog switch.

During the knob zero software routine, **KNOB AMP ZERO** is sent low, U26B opens and U26A closes; this disconnects the motor signal inputs to U27 and connects the inputs to ground (**GND G**). The A23 Microprocessor reads the output voltage of U27 via the DVM on the A17 Analog Instruction PCB and stores this reading. It then returns **KNOB AMP ZERO** to high, this opens U26A and closes U26B. The measurement of the U27 output voltage is then made. At very slow speeds this voltage will be very low, so the zero voltage of U27 will be subtracted from the motor voltage to give a more accurate reading of the voltage.

Without this zeroing of U27, the speed at which a parameter change is made would vary, depending on both the direction and speed of the motor. Also, without the zeroing, the offset voltages of U27 could cause a high enough output of U27 that would indicate apparent motor rotation when there was no actual motor rotation. U27 amplifies the motor voltage by five. Its output is clamped to about 8.2 volts by CR9 and CR10 to improve recovery time from an overdrive condition and to protect the analog multiplexer input on the A17 PCB. R5 isolates the output of U27 from the (front panel casting) filtercon shunt capacitance by effectively increasing the RC time constant.

6D-6.5 External Level Detector Preamplifier

The external level detector input (EXT LEVEL) from the front panel BNC connector goes to J6 pin 2 (**EXT LVL DET INPUT**). J6 pins 1 and 3 is the reference or ground side of the detector (**EXT LVL DET REF**). CR4 and CR5 clamp any signal on the two inputs to about +5.7 volts and CR6 and CR7 clamp the inputs to about –5.7 volts. R8 supplies the optimum load for the external detector to maintain optimum linearity with the leveling loop circuitry.

U28 is a unity gain, non-inverting amplifier that buffers the detector voltage. U29 is differential receiver with a gain of 5 that amplifies the external signal to the proper level for use by the A15 ALC PCB. Potentiometer R15 adjusts U29 input offset to optimize leveling at low power levels. Since most operational amplifiers do not work well with a capacitive load, R17 isolates the output of U29 from the capacitance of the front panel casting filtercon.

6D-7 FRONT PANEL ASSEMBLIES, TROUBLESHOOTING

Front panel assembly troubleshooting is covered entirely in Table 6D-2. Front panel disassembly procedures are covered in section 7.

6D-8 FRONT PANEL ASSEMBLIES, SERVICE SHEETS

Table 6D-1 on the first page of this section presents the arrangement of the block diagram, schematics, and parts locater diagrams for the A1 and A2 Front Panel Assembly PCBs.

Table 6D-2. Front Panel Troubleshooting (1 of 3)

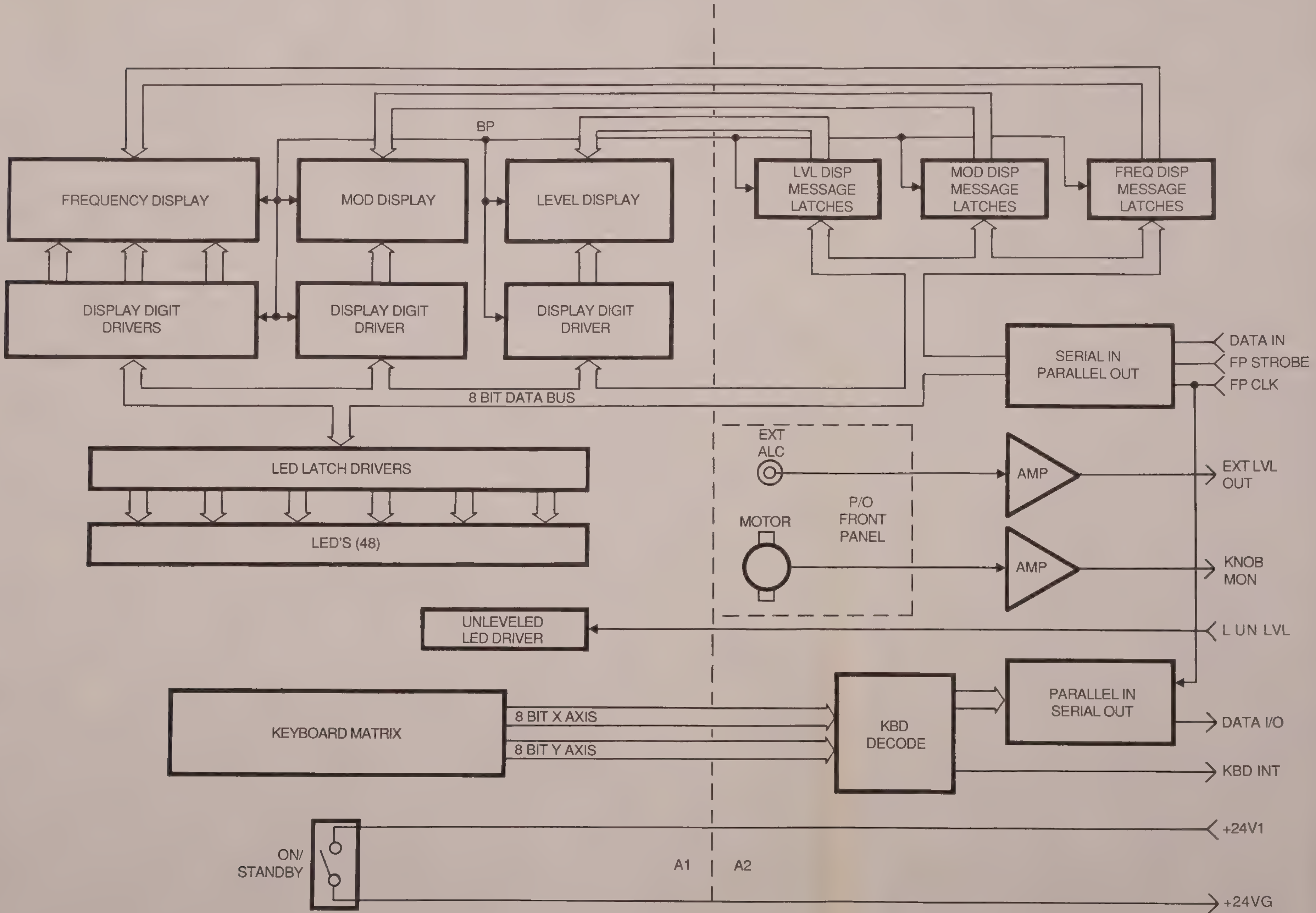
Trouble Category	Troubleshooting Procedure
	General Front Panel Troubleshooting
Preliminary Checks at Power On	In normal operation, the following occurs when instrument power is turned on: 1) The front panel LCDs and LEDs light in a random pattern for a few seconds, then blank while the instrument self test routine runs; 2) After self test finishes, the front panel displays the setup that was present when instrument power was last turned off. If the LCDs and LEDs don't change from their initial random pattern and front panel controls are inoperative, the problem lies in either the Digital Control assemblies (Section 6E) or the Front Panel assemblies (Section 6D). If the Digital Control assembly troubleshooting has not yet been done, complete the troubleshooting procedures in Section 6E before continuing with the following Front Panel assembly troubleshooting tests. The following procedures assume that the Digital Control assemblies have been eliminated as the cause of the problem. To disassemble the front panel assembly for troubleshooting, see Section 7, Disassembly and Repair Procedures.
Serial I/O Interface Problems	You should normally be able to determine if the serial I/O portion of the front panel is operating by observing the signals at the front panel interface on the front casting without even removing the front panel assembly from its casting. This should be done first to determine if the problem exists in the A8 Serial I/O or the front panel assembly. Synchronize the oscilloscope on the FP STRB signal at A28J1-6. You can then observe the FP DATA at A28J1-3 and the FP CLOCK at A28J1-4.
Serial I/O Key Response	To see if the serial I/O is responding to a key, syncronize the scope with the KBD INT signal on A28J1-7 and observe the FP CLOCK at A28J1-4 and the FP DATA at A28J1-5

Table 6D-2. Front Panel Troubleshooting (2 of 3)

Trouble Category	Troubleshooting Procedure
	General Front Panel Troubleshooting (Continued)
Serial-to-Parallel Conversion Circuitry	If the front panel displays don't change from the initial random pattern (following power on self test), the problem may lie in the A2 PCB's serial-to-parallel conversion circuits. **NOTE** There is a built-in service routine in the synthesizer to aid troubleshooting of the front panel circuits. It is implimented in one of two ways: 1) If there is front panel control via the keyboard, press SHIFT, TRIGGER, 019. 2) If there is no front panel control via the keyboard, send the following over the GPIB (the example shown is for the Wiltron 85). OUTPUT 705;"WH1 019" This service routine turns on all LCDs and LEDs (except the RF UNLEVELED LED) for a short period then blanks the displays; this sequence is repeated in a continuous loop.
LCD Problems	The backplane signal on each LCD is a +5 V square wave at about 150 Hz. The segment being driven also has a +5 V square wave at approximately 150 Hz in the on or off condition, however, in the *off* condition, the segment signal will be in phase with the backplane signal and in the *on* condition, it will be 180 degrees out of phase. If there is a segment not turning on, and you observe a differentiated square wave at its drive pin, it indicates that the drive from the driver IC is open. The differentiated square wave is due to the capacitive coupling of the backplane signal to the high impedance open circuit. This will also be affected by whether a X1 (1 MΩ) or X10 (10 MΩ) oscilloscope probe is used. (Make sure that the oscilloscope probe is also properly compensated before making these measurements.)
Front Panel Data, Clock, and Strobe Signals	Check the FP DATA, FP CLOCK, and FP STRB signals at A2U30 pins 4, 8, and 10 respectively. If the signals are present, the most likely suspect is the A2U1 data latch. If one or more of the signals is not present, the A2U30 buffer is probably defective. If some of the LCDs or LEDs remain on after the initial power on self test routine, a data latch or strobe latch is probably defective. Check the A2U7 and A2U8 strobe outputs with an oscilloscope during power on. Replace the IC that yields defective outputs.
Digit / Message Driver Cirtcuits	If the strobe lines appear to be in order, the most likely problem is a data latch. The message latches U12-U25 are located on the A2 PCB; the digit drivers for the LCDs and the LED drivers are located on the A1 PCB. By observing which message or group of messages is improper, the message-activate line can be traced to a specific latch. Sheets 2 and 3 of the A2 PCB schematic show the data latches and the message lines under their control. Sheets 3 and 4 of the A1 PCB schematics show the LCDs themselves with the message signals from the A2 PCB. From the latch, the signal can be traced through the A1/A2 interconnect cabling to the LCD socket. If one of the LCDs is missing a digit, or if one or a group of digits is improper, an LCD digit driver is probably defective. Sheets 3 and 4 of the A1 PCB schematic show the LCDs with the interconnects to their associated digit-driver ICs. Each of these digit drivers drive up to four of the digits on one LCD. If one segment of all digits is improper, a defective 8-bit data bus (D0-D7) is likely. This bus is driven by shift register A2U1 .

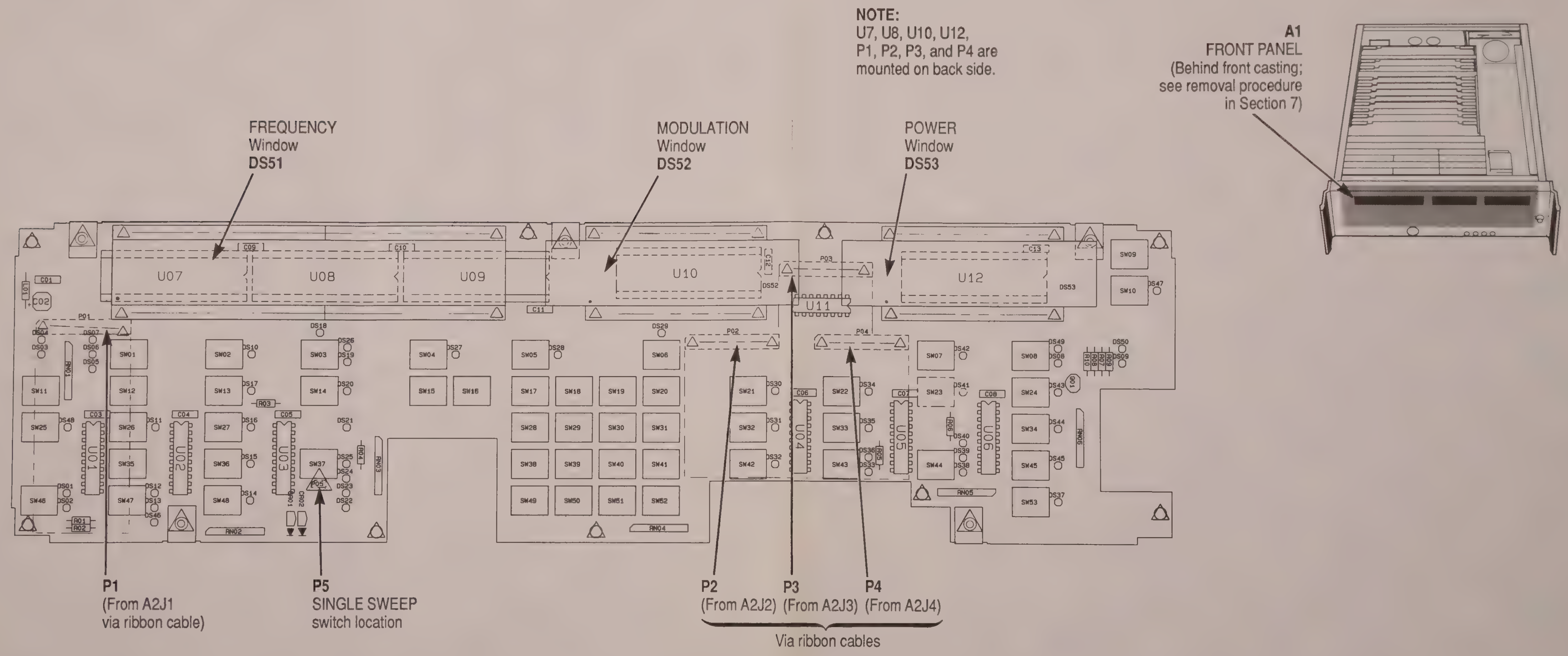
Table 6D-2. Front Panel Troubleshooting (3 of 3)

Trouble Category	Troubleshooting Procedure
	General Front Panel Troubleshooting (Continued)
Loss of Front Panel Control	If the front panel displays operate normally but you have lost front panel control, A2U10, A2U5A, or A2U11A circuitry is most likely defective. Check the KBD OUT signal at A2P1-7; it should go to TTL high when a key is depressed. If this signal response is proper, suspect the key matrix lines (X0-X7 or Y0-Y7), decoders A2U6 or A2U9, or the A2U10 shift register circuit. Press a key and monitor the outputs of A2U6 and A2U9; they should change to a new 8-bit code for each different key. If this is proper, check to see that the data is being shifted out of A2U10 in a serial format. The keys can easily be checked by monitoring the X and Y coordinate lines and pressing a key. When the key is pressed, the X and Y coordinate lines for that key will go from a TTL high to ground. An indication of a bad key switch would be that there is no response from the instrument for that key (the microprocessor will ignore improper keycodes).
DECREASE/INCREASE Knob Inoperative	Monitor KNOB MOTOR INPUT between A2J5-2 and A2J5-1,3 with a DVM or oscilloscope. Turning the knob should produce a voltage. The magnitude of this voltage will increase with the speed that the knob is turned; the polarity will change with the direction of rotation. If no voltage is measured, remove the plug from A2J5 and measure the output at the plug contacts. If the voltage is proper, suspect either A2U5D, A2U26A or B, or the signal from the latch controlling these two circuits. If no voltage is measured on the plug, the motor assembly should be checked by disconnecting it from its connector on the A2 board and connecting an external 5 volt supply to it. It should turn in one direction with one polarity and in the other with the other polarity. Replace it if it does not respond. If the voltage at A2J5 is proper, measure the knob amp output voltage at A2U27-6 (KNOB MON). This voltage should be the opposite polarity and be 10 times the magnitude of the input voltage at A2J5. The U27 knob amplifier can be checked by applying a 0.5 volt DC voltage between J5-2 an J5-1,3. The KNOB MON output signal should be amplified by a factor of 10 and be of opposite polarity. If this voltage is improper, A2U27 or its associated circuitry is defective. If the voltage is proper, troubleshoot the A17 Analog Instruction PCB DVM circuit in section 10K.
No Output From the External ALC Preamplifier	Connect a DC voltage source set to +1 Vp-p square wave to the front panel EXT LEVEL BNC input. Measure the FP ALC INPUT voltage at A2P4-3; it should have an amplitude gain of 5 and should have the opposite polarity of the input signal. If this voltage is improper, A2U28 or A2U29 circuitry is defective. If this voltage is proper, go to the ALC troubleshooting in section 10M. With a detector connected to the EXT LEVEL input and no RF applied to the detector, A2R15 is adjusted for 0V ±10µV.


BP
FREQUENCY DISPLAY
MOD DISPLAY
LEVEL DISPLAY
LVL DISP MESSAGE LATCHES
MOD DISP MESSAGE LATCHES
FREQ DISP MESSAGE LATCHES
DISPLAY DIGIT DRIVERS
DISPLAY DIGIT DRIVER
DISPLAY DIGIT DRIVER
SERIAL IN PARALLEL OUT
DATA IN
FP STROBE
FP CLK
8 BIT DATA BUS
LED LATCH DRIVERS
LED'S (48)
EXT ALC
MOTOR
P/O FRONT PANEL
AMP
AMP
EXT LVL OUT
KNOB MON
UNLEVELED LED DRIVER
L UN LVL
KEYBOARD MATRIX
8 BIT X AXIS
8 BIT Y AXIS
KBD DECODE
PARALLEL IN SERIAL OUT
DATA I/O
KBD INT
ON/ STANDBY
+24V1
A1
A2
+24VG

L6700A022

Figure 6D-1. Front Panel Block Diagram


NOTE:
U7, U8, U10, U12,
P1, P2, P3, and P4 are
mounted on back side.

A1
FRONT PANEL
(Behind front casting;
see removal procedure
in Section 7)

FREQUENCY
Window
DS51

MODULATION
Window
DS52

POWER
Window
DS53

P1
(From A2J1
via ribbon cable)

P5
SINGLE SWEEP
switch location

P2
(From A2J2)

P3
(From A2J3)

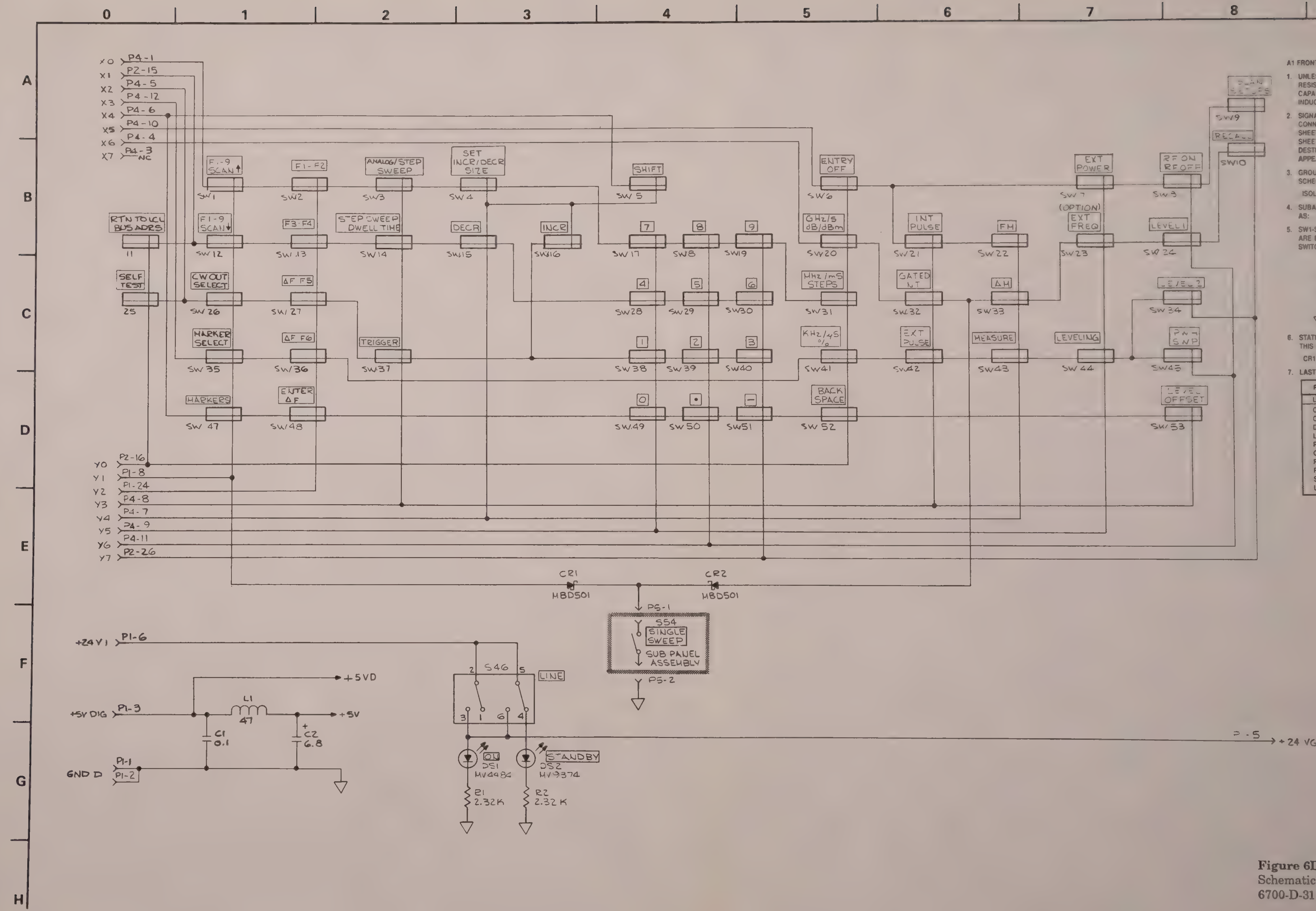
P4
(From A2J4)

Via ribbon cables

U07
U08
U09
U10
U11
U12
U01
U02
U03
U04
U05
U06
P01
P02
P03
P04
P05
DS52
DS53
SW01
SW02
SW03
SW04
SW05
SW06
SW07
SW08
SW09
SW10
SW11
SW12
SW13
SW14
SW15
SW16
SW17
SW18
SW19
SW20
SW21
SW22
SW23
SW24
SW25
SW26
SW27
SW28
SW29
SW30
SW31
SW32
SW33
SW34
SW35
SW36
SW37
SW38
SW39
SW40
SW41
SW42
SW43
SW44
SW45
SW46
SW47
SW48
SW49
SW50
SW51
SW52
SW53
C01
C02
C03
C04
C05
C06
C07
C08
C09
C10
C11
C12
C13
RN01
RN02
RN03
RN04
RN05
RN06
R01
R02
R03
R04
R05
R06
CR01
CR02

NOTE:
Leading zeros on
component number
references may be
disregarded.

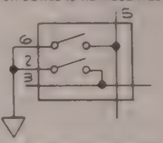
Figure 6D-2. A1 Front Panel PCB
Parts Locater Diagram
6700-D-31701-3 (Rev. C)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
X0 P4-1
X1 P2-15
X2 P4-5
X3 P4-12
X4 P4-6
X5 P4-10
X6 P4-4
X7 P4-3 NC
F1-9 SCAN↑
SW1
F1-F2
SW2
ANALOG/STEP SWEEP
SW3
SET INCR/DECR SIZE
SW4
SHIFT
SW5
ENTRY OFF
SW6
EXT POWER
SW7
RF ON RF OFF
SW8
SCAN SETUPS
SW9
RECALL
SW10
RTN TO LCL BUS ADRS
11
F1-9 SCAN↓
SW12
F3-F4
SW13
STEP SWEEP DWELL TIME
SW14
DECR
SW15
INCR
SW16
7
SW17
8
SW18
9
SW19
GHz/S dB/dBm
SW20
INT PULSE
SW21
FH
SW22
(OPTION) EXT FREQ
SW23
LEVEL 1
SW24
SELF TEST
25
CW OUT SELECT
SW26
ΔF F5
SW27
4
SW28
5
SW29
6
SW30
MHz/mS STEPS
SW31
GATED INT
SW32
ΔH
SW33
LEVEL 2
SW34
MARKER SELECT
SW35
ΔF F6
SW36
TRIGGER
SW37
1
SW38
2
SW39
3
SW40
KHz/μS %
SW41
EXT PULSE
SW42
MEASURE
SW43
LEVELING
SW44
PWR SWP
SW45
MARKERS
SW47
ENTER ΔF
SW48
0
SW49
•
SW50
—
SW51
BACK SPACE
SW52
LEVEL OFFSET
SW53
Y0 P2-16
Y1 P1-8
Y2 P1-24
Y3 P4-8
Y4 P4-7
Y5 P4-9
Y6 P4-11
Y7 P2-26
CR1 MBD501
CR2 MBD501
P5-1
S54 SINGLE SWEEP
SUB PANEL ASSEMBLY
P5-2
+24 V P1-6
2 S46 5
LINE
3 1 6 4
+5VD
+5V DIG P1-3
L1 47
+5V
C1 0.1
C2 6.8
GND D P1-1 P1-2
ON DS1 MV4484
STANDBY DS2 MV9374
R1 2.32K
R2 2.32K
P-5
+24 VG OUT

A1 FRONT PANEL SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG:
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   ISOLATED GROUNDS
4. SUBASSEMBLY BORDERS ARE DENOTED AS:
5. SW1-SW53 FRONT PANEL SWITCH LABELS ARE BOXED FOR CLARITY. ELECTRICAL SWITCH DETAIL IS REPRESENTED AS:



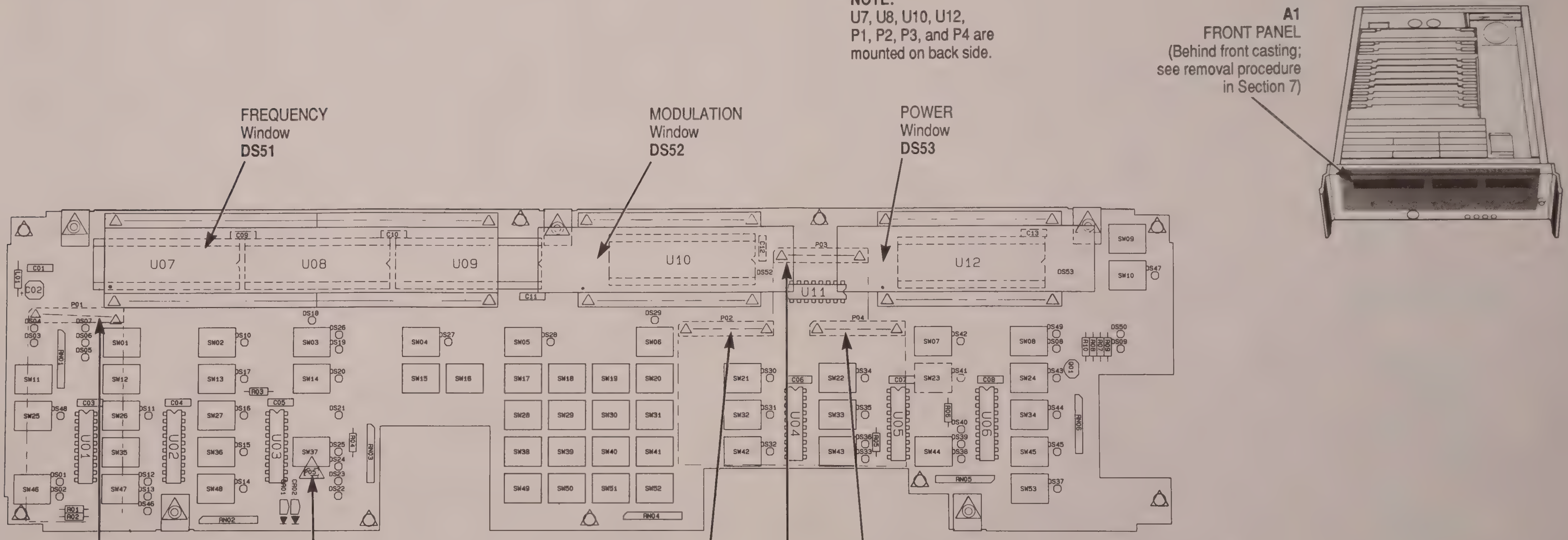
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   CR1, CR2, U1-U12
7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C13	DS41
CR2	SW23
DS53	
L1	
P5	
Q1	
R10	
RN6	
S53	
U12	

Figure 6D-3. A1 Front Panel PCB Schematic Diagram (Sheet 1 of 4) 6700-D-31701-3 (Rev. C)

NOTE:
U7, U8, U10, U12,
P1, P2, P3, and P4 are
mounted on back side.


A1
FRONT PANEL
(Behind front casting;
see removal procedure
in Section 7)
FREQUENCY
Window
DS51
MODULATION
Window
DS52
POWER
Window
DS53
U07
U08
U09
U10
U11
U12
U01
U02
U03
U04
U05
U06
P1
(From A2J1
via ribbon cable)
P5
SINGLE SWEEP
switch location
P2
(From A2J2)
P3
(From A2J3)
P4
(From A2J4)
Via ribbon cables

NOTE:
Leading zeros on
component number
references may be
disregarded.

Copy of Figure 6D-2. A1 Front Panel PCB Parts Locater Diagram
6700-D-31701-3 (Rev. C)

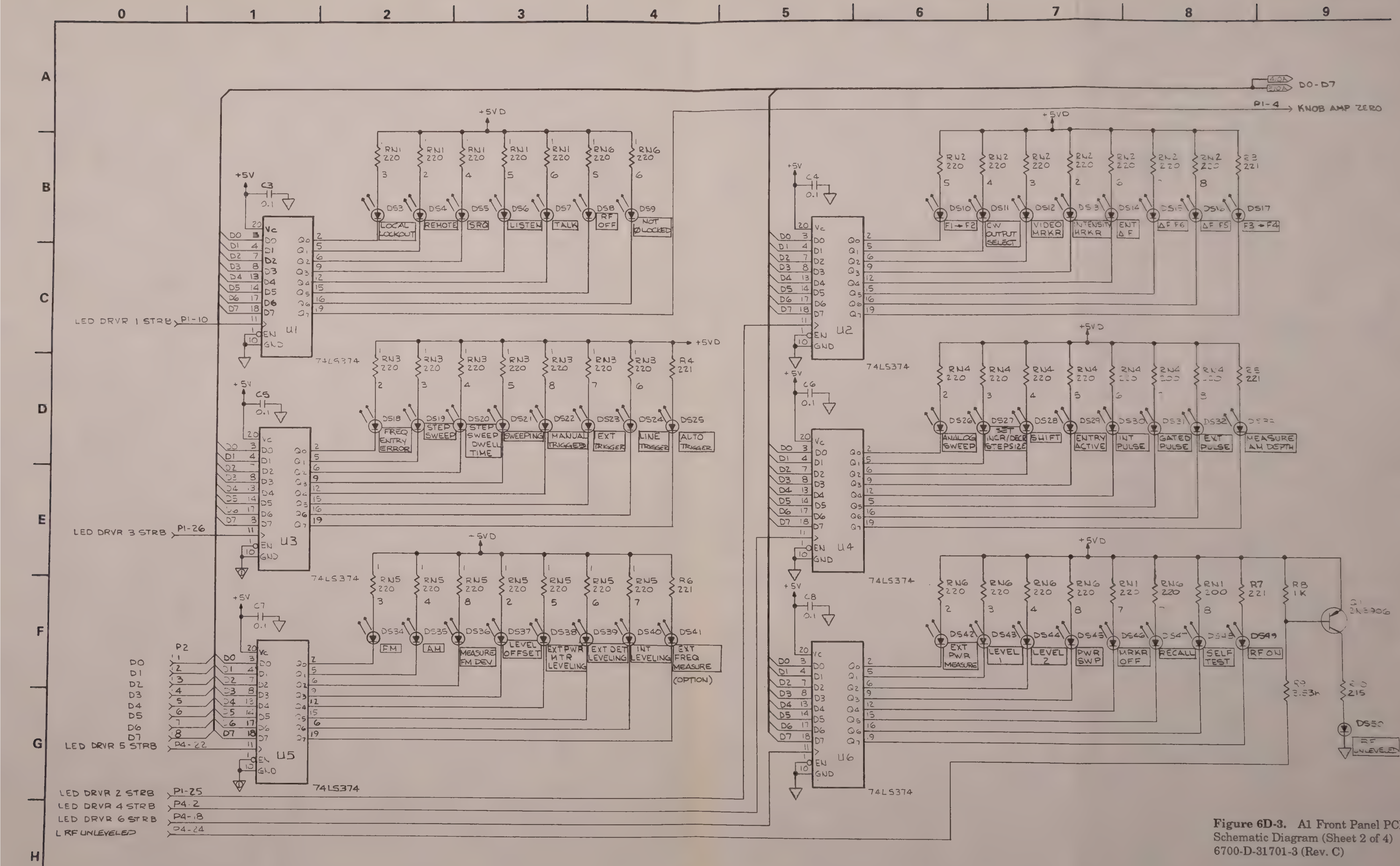
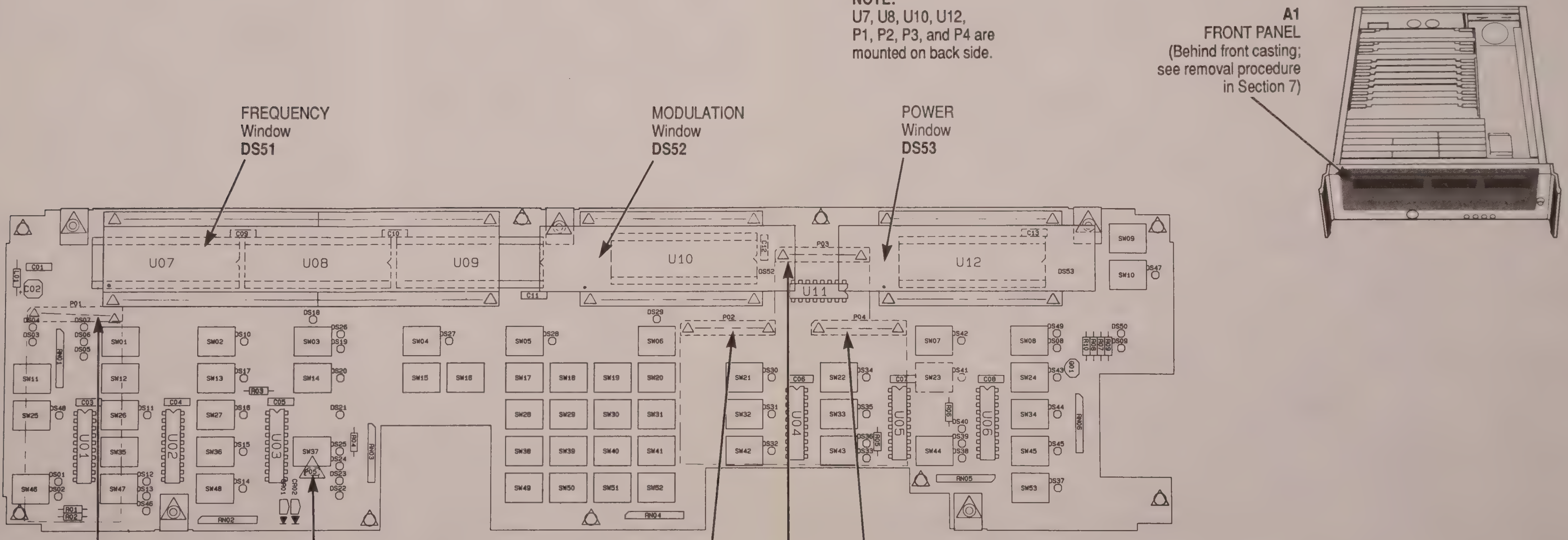

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
D0-D7
P1-4
KNOB AMP ZERO
+5VD
+5V
C3 0.1
C4 0.1
C5 0.1
C6 0.1
C7 0.1
C8 0.1
U1
U2
U3
U4
U5
U6
74LS374
Vc
EN
GND
D0 D1 D2 D3 D4 D5 D6 D7
Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7
RN1 220
RN2 220
RN3 220
RN4 220
RN5 220
RN6 220
R3 221
R4 221
R5 221
R6 221
R7 221
R8 1K
R9 3.83K
R10 215
Q1 2N3906
DS3 LOCAL LOCKOUT
DS4 REMOTE
DS5 SRQ
DS6 LISTEN
DS7 TALK
DS8 RF OFF
DS9 NOT LOCKED
DS10 F1→F2
DS11 CW OUTPUT SELECT
DS12 VIDEO MRKR
DS13 INTENSITY MRKR
DS14 ENT ΔF
DS15 ΔF F6
DS16 ΔF F5
DS17 F3→F4
DS18 FREQ ENTRY ERROR
DS19 STEP SWEEP
DS20 STEP SWEEP DWELL TIME
DS21 SWEEPING
DS22 MANUAL TRIGGER
DS23 EXT TRIGGER
DS24 LINE TRIGGER
DS25 AUTO TRIGGER
DS26 ANALOG SWEEP
DS27 SET INCR/DECR STEPSIZE
DS28 SHIFT
DS29 ENTRY ACTIVE
DS30 INT PULSE
DS31 GATED PULSE
DS32 EXT PULSE
DS33 MEASURE AM DEPTH
DS34 FM
DS35 AM
DS36 MEASURE FM DEV
DS37 LEVEL OFFSET
DS38 EXT PWR MTR LEVELING
DS39 EXT DET LEVELING
DS40 INT LEVELING
DS41 EXT FREQ MEASURE (OPTION)
DS42 EXT PWR MEASURE
DS43 LEVEL 1
DS44 LEVEL 2
DS45 PWR SWP
DS46 MRKR OFF
DS47 RECALL
DS48 SELF TEST
DS49 RF ON
DS50 RF UNLEVELED
LED DRVR 1 STRB P1-10
LED DRVR 3 STRB P1-26
LED DRVR 5 STRB P4-22
P2
LED DRVR 2 STRB P1-25
LED DRVR 4 STRB P4-2
LED DRVR 6 STRB P4-18
L RF UNLEVELED P4-24

Figure 6D-3. A1 Front Panel PCB Schematic Diagram (Sheet 2 of 4) 6700-D-31701-3 (Rev. C)


U07
U08
U09
U10
U11
U12
U01
U02
U03
U04
U05
U06
SW01
SW02
SW03
SW04
SW05
SW06
SW07
SW08
SW09
SW10
SW11
SW12
SW13
SW14
SW15
SW16
SW17
SW18
SW19
SW20
SW21
SW22
SW23
SW24
SW25
SW26
SW27
SW28
SW29
SW30
SW31
SW32
SW33
SW34
SW35
SW36
SW37
SW38
SW39
SW40
SW41
SW42
SW43
SW44
SW45
SW46
SW47
SW48
SW49
SW50
SW51
SW52
SW53
P01
P02
P03
P04
P05
C01
C02
C03
C04
C05
C06
C07
C08
C09
C10
C11
C12
C13
RN01
RN02
RN03
RN04
RN05
RN06
DS52
DS53

NOTE:
U7, U8, U10, U12,
P1, P2, P3, and P4 are
mounted on back side.

A1
FRONT PANEL
(Behind front casting;
see removal procedure
in Section 7)

FREQUENCY
Window
DS51

MODULATION
Window
DS52

POWER
Window
DS53

P1
(From A2J1
via ribbon cable)

P5
SINGLE SWEEP
switch location

P2 (From A2J2) **P3** (From A2J3) **P4** (From A2J4)
Via ribbon cables

NOTE:
Leading zeros on
component number
references may be
disregarded.

Copy of Figure 6D-2. A1 Front Panel PCB
Parts Locater Diagram
6700-D-31701-3 (Rev. C)

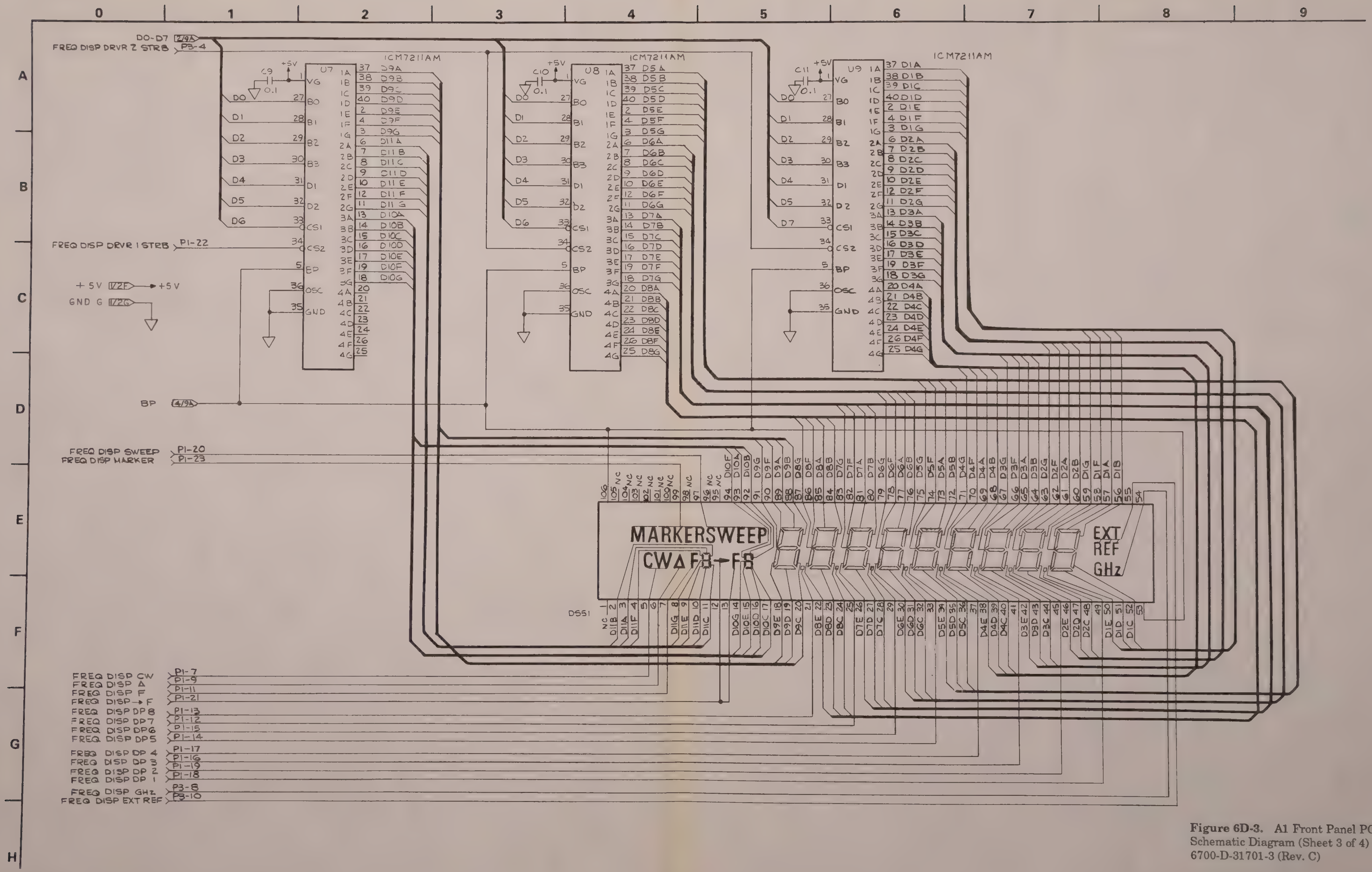
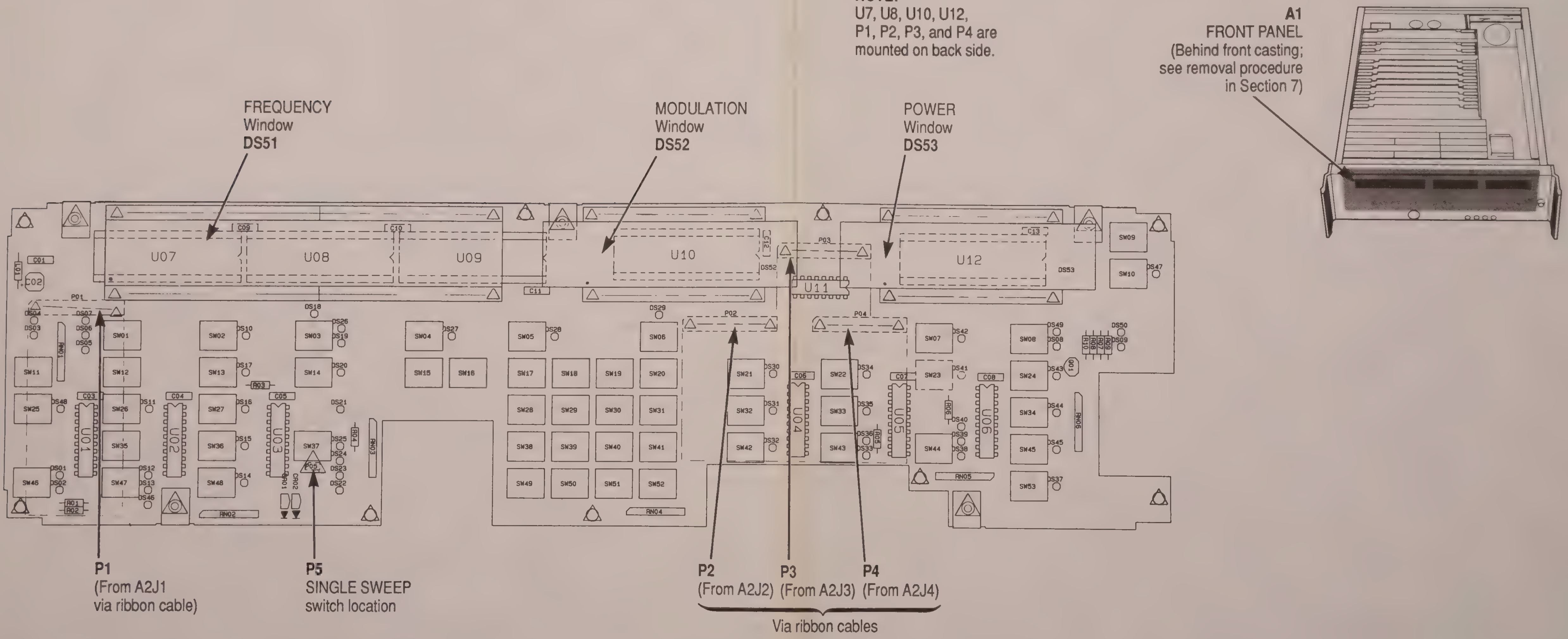

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
D0-D7 2/9A
FREQ DISP DRVR 2 STRB P3-4
FREQ DISP DRVR 1 STRB P1-22
+5V 17/2F +5V
GND G 17/2G
BP 4/9A
FREQ DISP SWEEP P1-20
FREQ DISP MARKER P1-23
ICM7211AM
U7
U8
U9
C9 0.1
C10 0.1
C11 0.1
+5V
VG
B0
B1
B2
B3
D1
D2
CS1
CS2
BP
OSC
GND
D0
D1
D2
D3
D4
D5
D6
D7
D9A
D9B
D9C
D9D
D9E
D9F
D9G
D11A
D11B
D11C
D11D
D11E
D11F
D11G
D10A
D10B
D10C
D10D
D10E
D10F
D10G
D5A
D5B
D5C
D5D
D5E
D5F
D5G
D6A
D6B
D6C
D6D
D6E
D6F
D6G
D7A
D7B
D7C
D7D
D7E
D7F
D7G
D8A
D8B
D8C
D8D
D8E
D8F
D8G
D1A
D1B
D1C
D1D
D1E
D1F
D1G
D2A
D2B
D2C
D2D
D2E
D2F
D2G
D3A
D3B
D3C
D3D
D3E
D3F
D3G
D4A
D4B
D4C
D4D
D4E
D4F
D4G
NC
DS51
MARKERSWEEP
CW∆F8→F8
EXT
REF
GHz
FREQ DISP CW P1-7
FREQ DISP ∆ P1-9
FREQ DISP F P1-11
FREQ DISP → F P1-21
FREQ DISP DP 8 P1-13
FREQ DISP DP 7 P1-12
FREQ DISP DP 6 P1-15
FREQ DISP DP 5 P1-14
FREQ DISP DP 4 P1-17
FREQ DISP DP 3 P1-16
FREQ DISP DP 2 P1-19
FREQ DISP DP 1 P1-18
FREQ DISP GHz P3-8
FREQ DISP EXT REF P3-10

Figure 6D-3. A1 Front Panel PCB Schematic Diagram (Sheet 3 of 4)
6700-D-31701-3 (Rev. C)

NOTE:
U7, U8, U10, U12,
P1, P2, P3, and P4 are
mounted on back side.


A1
FRONT PANEL
(Behind front casting;
see removal procedure
in Section 7)
FREQUENCY
Window
DS51
MODULATION
Window
DS52
POWER
Window
DS53
U07
U08
U09
U10
U11
U12
U01
U02
U03
U04
U05
U06
P1
(From A2J1
via ribbon cable)
P5
SINGLE SWEEP
switch location
P2
(From A2J2)
P3
(From A2J3)
P4
(From A2J4)
Via ribbon cables

NOTE:
Leading zeros on
component number
references may be
disregarded.

Copy of Figure 6D-2. A1 Front Panel PCB
Parts Locater Diagram
6700-D-31701-3 (Rev. C)

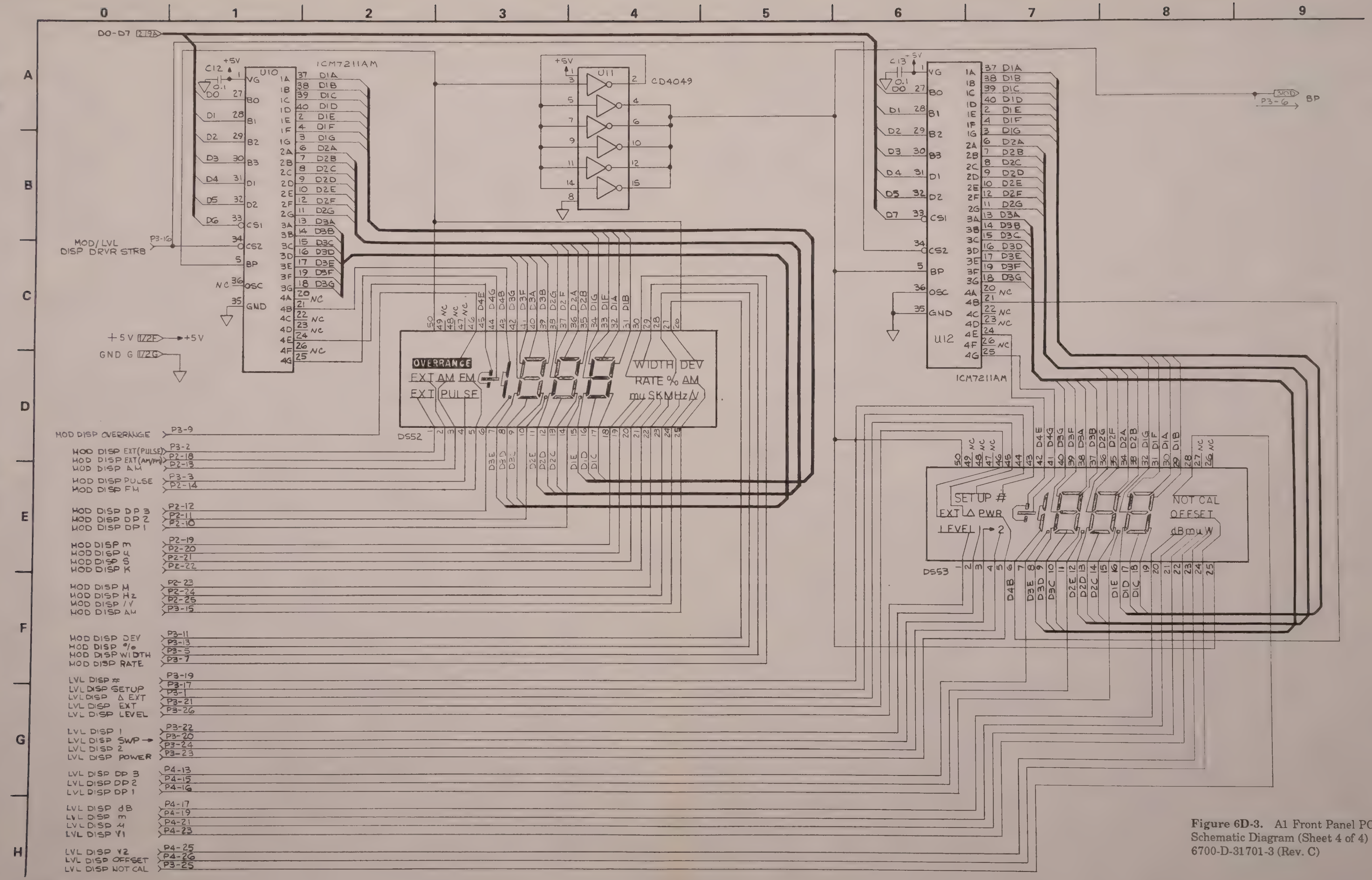
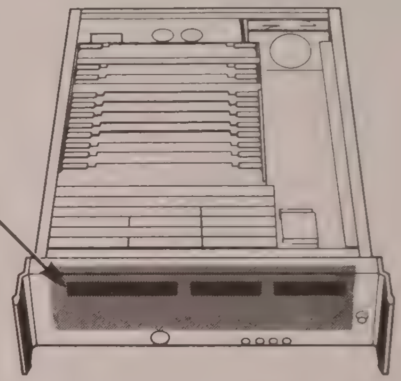

D0-D7 2/9A
U10
ICM7211AM
U11
CD4049
U12
ICM7211AM
C12 0.1
C13 0.1
+5V
BP
P3-6
3/10D
MOD/LVL DISP DRVR STRB
P3-16
+5V 1/2F +5V
GND G 1/2G
DS52
DS53
OVERRANGE
EXT AM FM
EXT PULSE
WIDTH DEV
RATE % AM
mu S K MHz /V
SETUP #
EXT △ PWR
LEVEL 1 → 2
NOT CAL
OFFSET
dB m u W
MOD DISP OVERRANGE P3-9
MOD DISP EXT(PULSE) P3-2
MOD DISP EXT(AM/FM) P2-18
MOD DISP AM P2-13
MOD DISP PULSE P3-3
MOD DISP FM P2-14
MOD DISP DP 3 P2-12
MOD DISP DP 2 P2-11
MOD DISP DP 1 P2-10
MOD DISP m P2-19
MOD DISP u P2-20
MOD DISP S P2-21
MOD DISP K P2-22
MOD DISP M P2-23
MOD DISP Hz P2-24
MOD DISP /V P2-25
MOD DISP AM P3-15
MOD DISP DEV P3-11
MOD DISP % P3-13
MOD DISP WIDTH P3-5
MOD DISP RATE P3-7
LVL DISP # P3-19
LVL DISP SETUP P3-17
LVL DISP △ EXT P3-1
LVL DISP EXT P3-21
LVL DISP LEVEL P3-26
LVL DISP 1 P3-22
LVL DISP SWP → P3-20
LVL DISP 2 P3-24
LVL DISP POWER P3-23
LVL DISP DP 3 P4-13
LVL DISP DP 2 P4-15
LVL DISP DP 1 P4-16
LVL DISP dB P4-17
LVL DISP m P4-19
LVL DISP u P4-21
LVL DISP V1 P4-23
LVL DISP V2 P4-25
LVL DISP OFFSET P4-26
LVL DISP NOT CAL P3-25

Figure 6D-3. A1 Front Panel PCB Schematic Diagram (Sheet 4 of 4) 6700-D-31701-3 (Rev. C)

NOTE:
P1, P2, and P4
are mounted on back side.

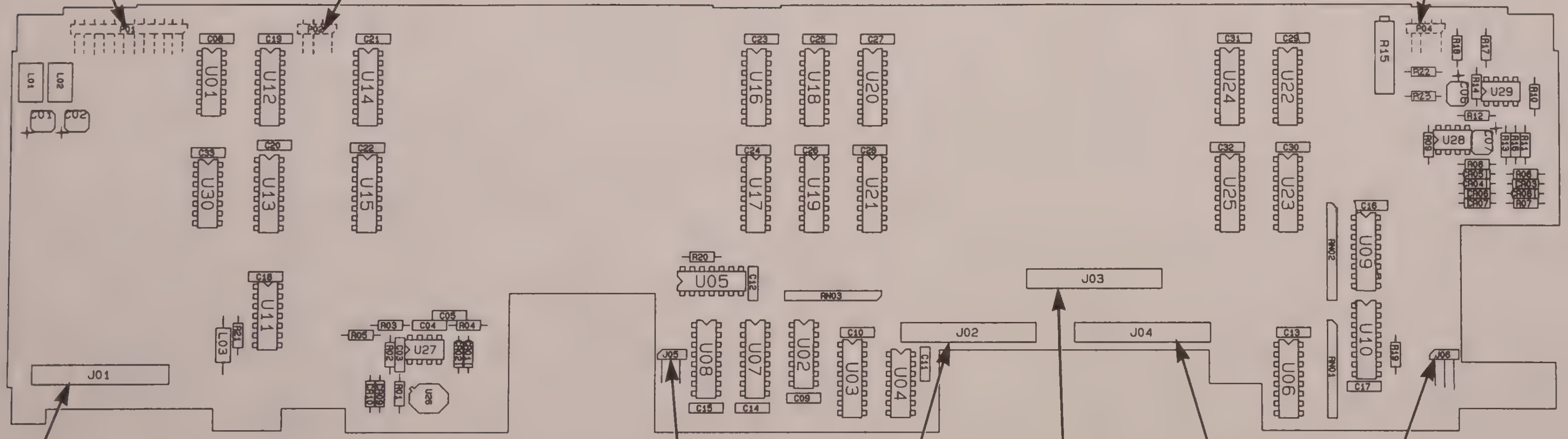
A2
FRONT PANEL CONTROL
(Behind front casting;
see removal procedure
in Section 7)



P1
(To A28J1
via wire harness)

P2
(To A28J2
via wire harness)

P4
(To A28J4
via wire harness)


P01
P02
P04
L01
L02
C01
C02
C08
C19
C21
U01
U12
U14
C23
C25
C27
U16
U18
U20
C31
C29
U24
U22
R15
R18
R17
R22
R23
U29
R16
R12
U28
R09
C35
C20
C22
U30
U13
U15
C24
C26
C28
U17
U19
U21
C32
C30
U25
U23
C16
U09
RN02
R20
U05
C12
RN03
J03
C18
U11
L03
R21
C05
R03
C04
R04
R05
U27
U26
R01
J01
J05
U08
U07
U02
C10
U03
U04
C11
J02
J04
C13
U06
RN01
U10
R19
J06
C15
C14
C09
C17

J1
(To A1P1
via ribbon cable)

J5
(To Knob Motor
via wire harness)

J2
(To A1P2
via ribbon cable)

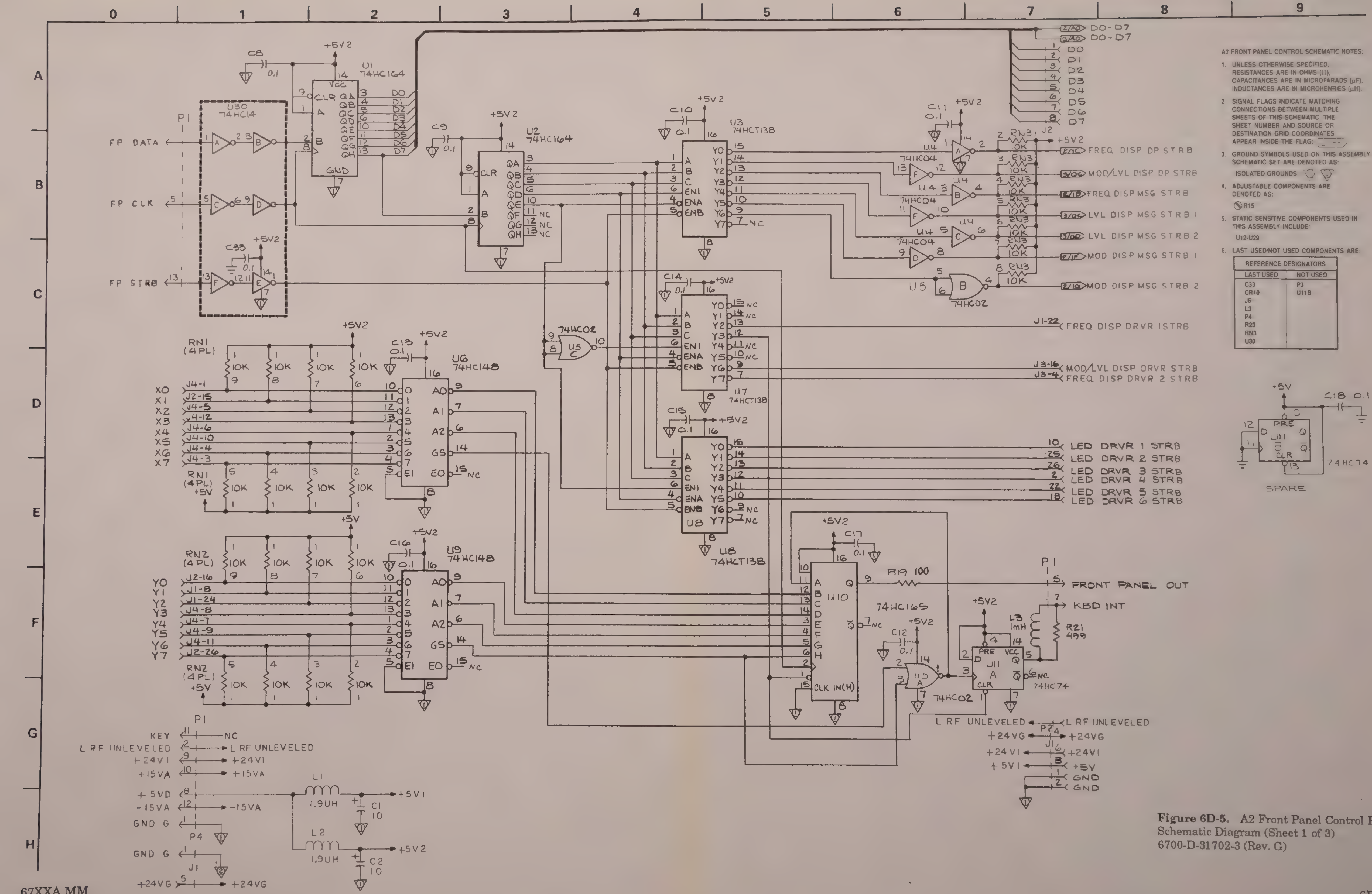
J3
(To A1P3
via ribbon cable)

J4
(To A1P4
via ribbon cable)

J6
EXT LEVEL Input
(Via wire harness
from BNC connector)

NOTE:
Leading zeros on
component number
references may be
disregarded.

Figure 6D-4. A2 Front Panel Control PCB
Parts Locater Diagram
6700-D-31702-3 (Rev. G)


FP DATA
FP CLK
FP STRB
P1
U30 74HC14
U1 74HC164
U2 74HC164
U3 74HCT138
U7 74HCT138
U8 74HCT138
U5 74HC02
U4 74HC04
U6 74HC148
U9 74HC148
U10 74HC165
U11 74HC74
D0-D7
FREQ DISP DP STRB
MOD/LVL DISP DP STRB
FREQ DISP MSG STRB
LVL DISP MSG STRB 1
LVL DISP MSG STRB 2
MOD DISP MSG STRB 1
MOD DISP MSG STRB 2
FREQ DISP DRVR 1STRB
MOD/LVL DISP DRVR STRB
FREQ DISP DRVR 2 STRB
LED DRVR 1 STRB
LED DRVR 2 STRB
LED DRVR 3 STRB
LED DRVR 4 STRB
LED DRVR 5 STRB
LED DRVR 6 STRB
X0 X1 X2 X3 X4 X5 X6 X7
Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7
RN1 (4PL)
RN2 (4PL)
RN3 10K
FRONT PANEL OUT
KBD INT
R19 100
R21 499
L3 1mH
SPARE
KEY
L RF UNLEVELED
+24VI
+15VA
+5VD
-15VA
GND G
+24VG
L1 1.9UH
L2 1.9UH
+5V1
+5V2

A2 FRONT PANEL CONTROL SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG:
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   ISOLATED GROUNDS
4. ADJUSTABLE COMPONENTS ARE DENOTED AS:

   R15
5. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE

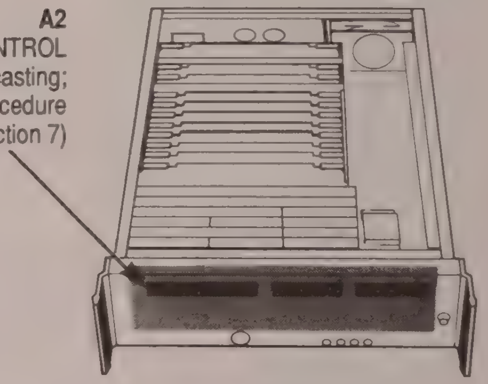
   U12-U29
6. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C33 CR10 J6 L3 P4 R23 RN3 U30	P3 U11B

Figure 6D-5. A2 Front Panel Control PCB Schematic Diagram (Sheet 1 of 3)
6700-D-31702-3 (Rev. G)

NOTE:
P1, P2, and P4
are mounted on back side.

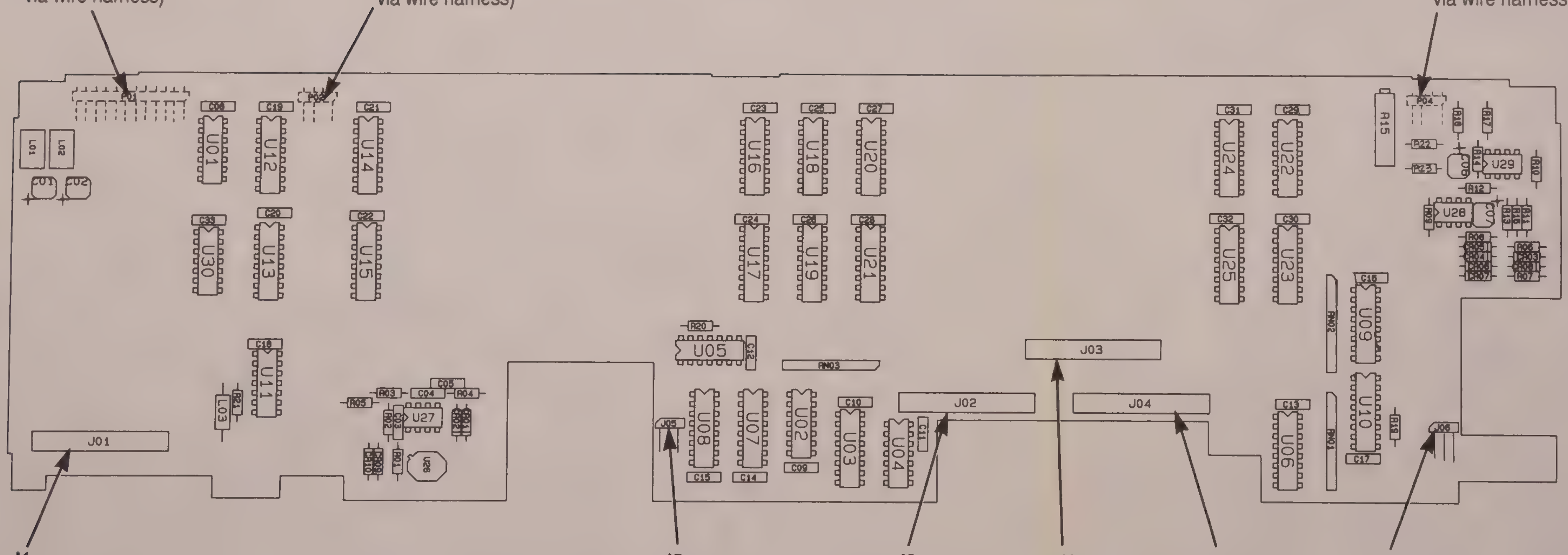
A2
FRONT PANEL CONTROL
(Behind front casting;
see removal procedure
in Section 7)



P1
(To A28J1
via wire harness)

P2
(To A28J2
via wire harness)

P4
(To A28J4
via wire harness)


P01
P02
P04
L01
L02
C01
C02
C08
C19
C21
U01
U12
U14
C33
C20
C22
U30
U13
U15
C18
U11
L03
R21
R03
R05
C04
C05
R04
U27
U26
C23
C25
C27
U16
U18
U20
C24
C26
C28
U17
U19
U21
R20
U05
C12
RN03
J05
U08
U07
U02
U03
U04
C10
C11
C09
C15
C14
J01
J02
J03
J04
C31
C29
U24
U22
C32
C30
U25
U23
R15
R22
R23
R12
U29
U28
C16
U09
RN02
U10
RN01
C17
C13
U06
J06

J1
(To A1P1
via ribbon cable)

J5
(To Knob Motor
via wire harness)

J2
(To A1P2
via ribbon cable)

J3
(To A1P3
via ribbon cable)

J4
(To A1P4
via ribbon cable)

J6
EXT LEVEL Input
(Via wire harness
from BNC connector)

NOTE:
Leading zeros on
component number
references may be
disregarded.

Copy of Figure 6D-4. A2 Front Panel Control PCB
Parts Locater Diagram
6700-D-31702-3 (Rev. G)

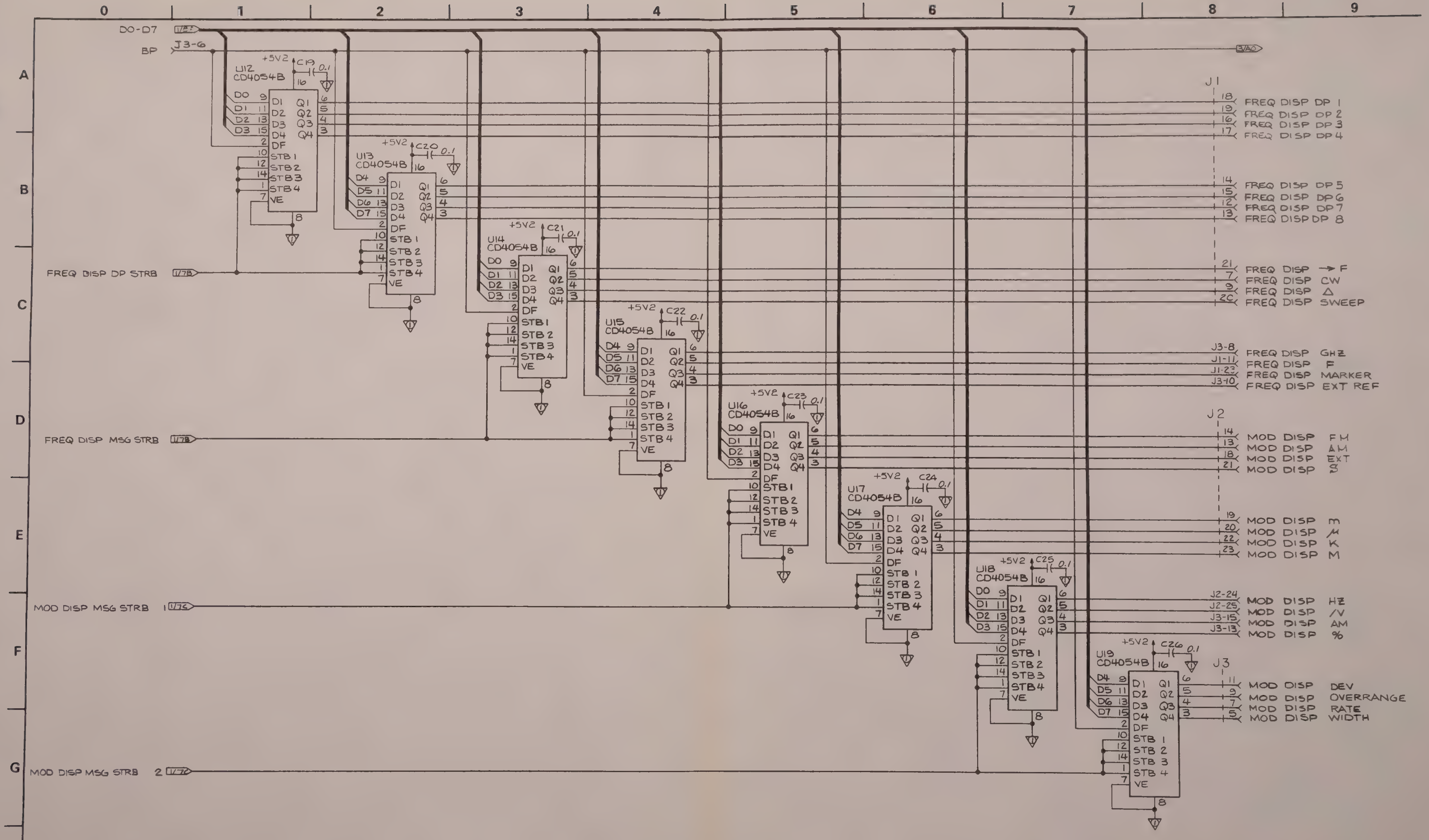
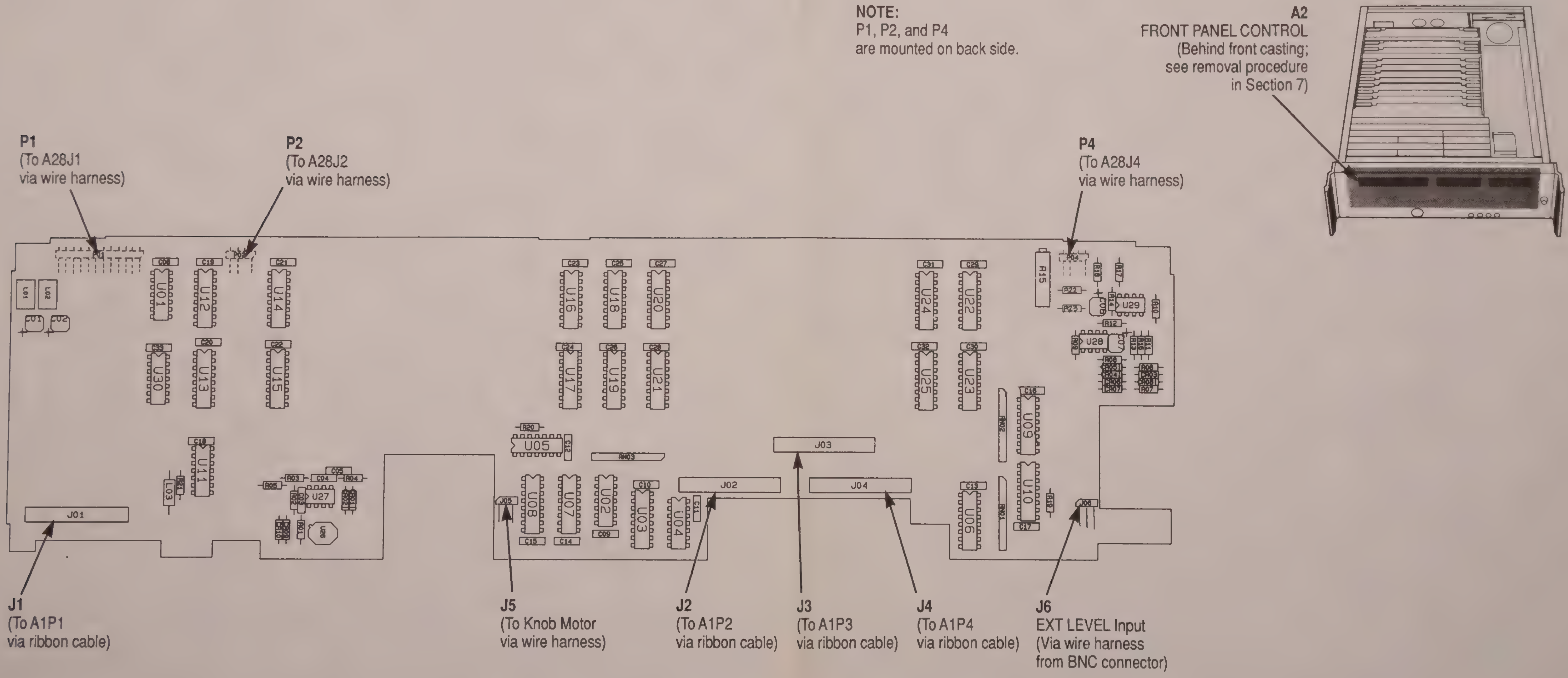

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
D0-D7
BP
J3-6
U12
CD4054B
U13
CD4054B
U14
CD4054B
U15
CD4054B
U16
CD4054B
U17
CD4054B
U18
CD4054B
U19
CD4054B
+5V2
C19 0.1
C20 0.1
C21 0.1
C22 0.1
C23 0.1
C24 0.1
C25 0.1
C26 0.1
D1 D2 D3 D4 DF STB1 STB2 STB3 STB4 VE
Q1 Q2 Q3 Q4
FREQ DISP DP STRB
FREQ DISP MSG STRB
MOD DISP MSG STRB 1
MOD DISP MSG STRB 2
J1
J2
J3
FREQ DISP DP 1
FREQ DISP DP 2
FREQ DISP DP 3
FREQ DISP DP 4
FREQ DISP DP 5
FREQ DISP DP 6
FREQ DISP DP 7
FREQ DISP DP 8
FREQ DISP → F
FREQ DISP CW
FREQ DISP Δ
FREQ DISP SWEEP
J3-8 FREQ DISP GHZ
J1-11 FREQ DISP F
J1-23 FREQ DISP MARKER
J3-10 FREQ DISP EXT REF
MOD DISP FM
MOD DISP AM
MOD DISP EXT
MOD DISP S
MOD DISP m
MOD DISP μ
MOD DISP K
MOD DISP M
J2-24 MOD DISP HZ
J2-25 MOD DISP /V
J3-15 MOD DISP AM
J3-13 MOD DISP %
MOD DISP DEV
MOD DISP OVERRANGE
MOD DISP RATE
MOD DISP WIDTH

Figure 6D-5. A2 Front Panel Control PCB Schematic Diagram (Sheet 2 of 3) 6700-D-31702-3 (Rev. G)


NOTE:
P1, P2, and P4
are mounted on back side.
A2
FRONT PANEL CONTROL
(Behind front casting;
see removal procedure
in Section 7)
P1
(To A28J1
via wire harness)
P2
(To A28J2
via wire harness)
P4
(To A28J4
via wire harness)
U01
U12
U14
U30
U13
U15
U11
U27
U16
U18
U20
U17
U19
U21
U05
U08
U07
U02
U03
U04
J01
J02
J03
J04
U24
U22
U25
U23
U09
U10
U06
U29
U28
R15
L03
J1
(To A1P1
via ribbon cable)
J5
(To Knob Motor
via wire harness)
J2
(To A1P2
via ribbon cable)
J3
(To A1P3
via ribbon cable)
J4
(To A1P4
via ribbon cable)
J6
EXT LEVEL Input
(Via wire harness
from BNC connector)

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6D-4. A2 Front Panel Control PCB Parts Locater Diagram
6700-D-31702-3 (Rev. G)

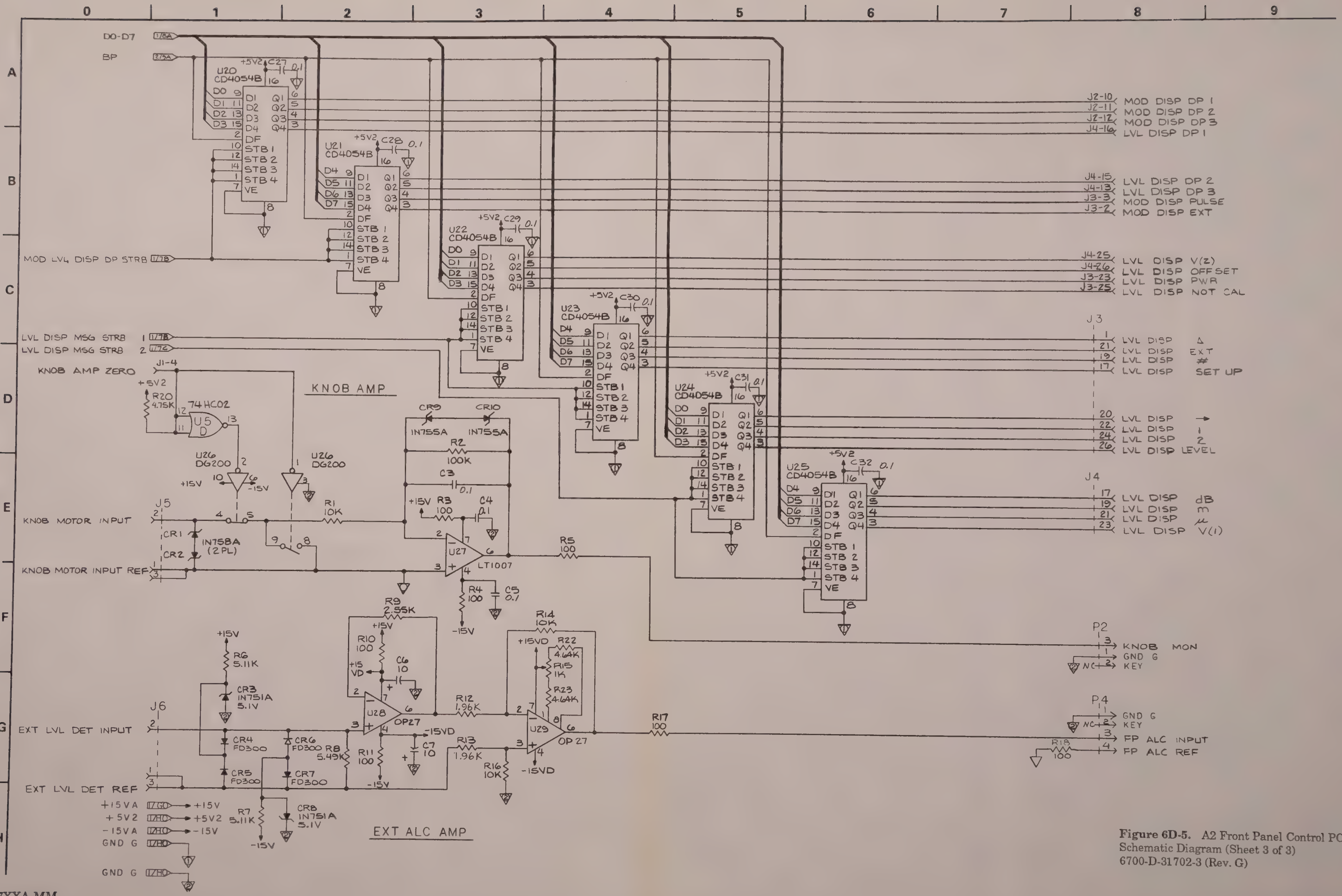

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
D0-D7
BP
U20
CD4054B
U21
CD4054B
U22
CD4054B
U23
CD4054B
U24
CD4054B
U25
CD4054B
+5V2
C27
C28
C29
C30
C31
C32
0.1
D1
D2
D3
D4
DF
STB 1
STB 2
STB 3
STB 4
VE
Q1
Q2
Q3
Q4
MOD LVL DISP DP STRB
LVL DISP MSG STRB 1
LVL DISP MSG STRB 2
J2-10 MOD DISP DP 1
J2-11 MOD DISP DP 2
J2-12 MOD DISP DP 3
J4-16 LVL DISP DP 1
J4-15 LVL DISP DP 2
J4-13 LVL DISP DP 3
J3-3 MOD DISP PULSE
J3-2 MOD DISP EXT
J4-25 LVL DISP V(2)
J4-26 LVL DISP OFFSET
J3-23 LVL DISP PWR
J3-25 LVL DISP NOT CAL
J3
1 LVL DISP Δ
21 LVL DISP EXT
19 LVL DISP #
17 LVL DISP SET UP
20 LVL DISP →
22 LVL DISP 1
24 LVL DISP 2
26 LVL DISP LEVEL
J4
17 LVL DISP dB
19 LVL DISP m
21 LVL DISP μ
23 LVL DISP V(1)
KNOB AMP ZERO
J1-4
+5V2
R20
4.75K
74HC02
U5
D
U26
DG200
+15V
-15V
KNOB AMP
CR9
CR10
1N755A
R2
100K
C3
0.1
R3
100
C4
0.1
R1
10K
U27
LT1007
R5
100
R4
100
C5
0.1
-15V
J5
KNOB MOTOR INPUT
KNOB MOTOR INPUT REF
CR1
CR2
1N758A
(2 PL)
P2
KNOB MON
GND G
KEY
NC
R9
2.55K
R10
100
+15 VD
C6
10
U28
OP27
-15VD
C7
10
R11
100
R12
1.96K
R13
1.96K
R14
10K
+15VD
R22
4.64K
R15
1K
R23
4.64K
U29
OP 27
R16
10K
R17
100
P4
GND G
KEY
FP ALC INPUT
FP ALC REF
R18
100
+15V
R6
5.11K
CR3
1N751A
5.1V
J6
EXT LVL DET INPUT
CR4
FD300
CR5
FD300
CR6
FD300
CR7
FD300
R8
5.49K
EXT LVL DET REF
R7
5.11K
CR8
1N751A
5.1V
EXT ALC AMP
+15VA → +15V
+5V2 → +5V2
-15VA → -15V
GND G
GND G

Figure 6D-5. A2 Front Panel Control PCB Schematic Diagram (Sheet 3 of 3) 6700-D-31702-3 (Rev. G)

6E– DIGITAL CONTROL A8, A23, and A24 PCBs

6E-1 DIGITAL CONTROL ASSEMBLIES: A23, A24, AND A8 PCBs

This section contains service information for the digital control assemblies listed in Table 6E-1 below. Refer also to the general reference information in Sections 6A, 6B, and 6C.

Table 6E-1. Digital Control Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6E-2	6E-1
Block Diagram	Fig. 6E-2	6E-13
Troubleshooting	Tbl. 6E-2	6E-6
PCB LEVEL		
A8 Digital Control PCB		
General Circuit Description	Para. 6E-5	6E-3
Detailed Circuit Description	Para. 6E-6	6E-4
Block Diagram	Fig. 6E-3	6E-13
Troubleshooting	Tbl. 6E-2	6E-6
Parts Locator Diagram	Fig. 6E-10	6E-22
Schematic (Sheet 1 of 1)	Fig. 6E-11	6E-23
A23 Microprocessor PCB		
General Circuit Description	Para. 6E-3	6E-1
Block Diagram	Fig. 6E-4	6E-14
Troubleshooting	Tbl. 6E-2	6E-6
Parts Locator Diagram	Fig. 6E-6	6E-16
Schematic (Sheet 1 of 2)	Fig. 6E-7	6E-17
(Sheet 2 of 2)	"	6E-19
A24 GPIB PCB		
General Circuit Description	Para. 6E-4	6E-2
Block Diagram	Fig. 6E-5	6E-15
Troubleshooting	Tbl. 6E-2	6E-6
Parts Locator Diagram	Fig. 6E-8	6E-20
Schematic (Sheet 1 of 1)	Fig. 6E-9	6E-21

6E-2 DIGITAL CONTROL ASSEMBLIES, OVERALL DESCRIPTION

The digital control assemblies consist of the A23 Microprocessor PCB, A24 GPIB PCB, and A8 Serial I/O PCB. These assemblies control the synthesizer either locally via the front panel or remotely over the IEEE-488 General Purpose Interface Bus (GPIB).

The A23 Microprocessor PCB has the leading role in this group. It controls the A23, A8, A15, A16, A17, and A29 PCBs using two buses, each having 8-bit data and 3-bit address lines. In addition, each PCB has its own control line from the A23 board.

The A24 GPIB PCB interfaces with the A23 Microprocessor PCB using interrupts. When an (external) GPIB controller sends a command to the synthesizer, the A24 PCB decodes the command and sends an interrupt to the main microprocessor on the A23 PCB. This interrupt has the highest priority of any other interrupts that may be present. Upon being interrupted, the main microprocessor processes the command from the GPIB and performs the required task.

The A2 Front Panel Control, A6 Coarse Loop Divider, A11 Fine Loop Divider, and A13 Pulse Generator PCBs receive commands from the A23 Microprocessor PCB via the A8 Serial I/O PCB. Since these boards are sensitive to the high-frequency components of the 8-bit microprocessor bus signals, they are controlled through a serial bus. The main microprocessor sends information in parallel to the A8 board which then converts the information to a serial format. This serial bus signal is much slower. It transits the filter networks for each of the PCBs on the serial bus with much less interference than could the high-speed parallel-bus signals.

6E-3 A23 MICROPROCESSOR PCB, GENERAL DESCRIPTION

Refer to the block diagram in Figure 6E-4 for the following discussion. The A23 PCB central processing unit (CPU) is an 8088, 16-bit microprocessor operating at a 5 MHz clock rate. Integrated circuit U1 provides the 5 MHz clock (derived from a 15 MHz crystal). U1 also provides 2 wait states (total of 400 ns) when the microprocessor is addressing hardware outside of the A23 PCB. The address and data buses of the 8088 are multiplexed. U10 and U11 separate the address bus from the multiplexed data-address.

The on-board memory has the following capabilities.

- 64 K of EPROM (expandable to 128 K) for storing the main operating program of the synthesizer. This is also called firmware.
- 16 K of EEPROM (expandable to 64 K) for storing calibration data. This EEPROM is electrically erasable and is programmed by the main microprocessor during calibration. The reprogramming is enabled by a jumper (P2, CAL/NORMAL).
- 8 K of non-volatile RAM for storing front panel setups in the power-off condition. The battery for this RAM is part of the memory's integrated circuit structure and requires no external charging circuitry.
- 16 K of general purpose scratch-pad RAM.

As shown in Figure 6E-4, the address bus goes to the U14 port latch where it is decoded to the PCB address bus lines (**PA0–PA2**) and to latches U18 and U19. These latches provide additional decoding that enables the individual board address lines—used in combination with the board address bus—to send and receive information to the other PCBs.

The microprocessor data bus also goes to the U16 buffer-latch and then to the other PCBs on the data bus. U17 receives data from the data bus sent by either the A24 GPIB PCB, the A8 Serial I/O PCB, or the DVM circuit on the A17 PCB. U15 provides a start up instruction to the microprocessor at instrument turn on.

A second circuit in latch U18 provides the interrupt control for the microprocessor. These interrupts are handled on a priority basis. The GPIB has top priority; the front panel has the lowest priority.

Of the lines entering Interrupt Control(ler) U8, the **LFF INT** (Low Fast Frequency) signal comes from the A24 GPIB PCB and is used when fast frequency stepping is desired over the GPIB. For fast frequency stepping, up to 512 frequencies are stored in RAM in either sequential or non-sequential order. Then, each time the A24 PCB receives a group execute trigger (GET) command from the GPIB, it sends an LFF interrupt. The microprocessor then commands the synthesizer to go to the next frequency stored in the frequency look-up table. This reduces the time required for the GPIB microprocessor to process the frequency commands and request service from the main microprocessor.

The **DWELL INT** line comes from the A17 Analog Instruction PCB during analog sweep operations. This interrupt tells the microprocessor that a dwell has occurred and that it must now process either a bandswitch, retrace, or beginning of a new sweep.

The interrupts from the U6 counter and U7 timer provide timing signals for waits. Waits include time allowance for the phase-lock loops to achieve lock. During these waits, the microprocessor does other tasks. Then, upon timing out, the timer sends the interrupt, and the microprocessor services the next required task. There is also a housekeeping routine that uses these timers; it occurs every 50 ms. In the housekeeping routine, the microprocessor checks for phase lock on each of the loops and monitors such items as the power meter, AM, FM, and rear panel DIP switches located on the A27 Auxiliary I/O PCB.

The remaining two inputs to the PCB, **LINE TRIG** and **EXT TRIG**, are multiplexed to one signal that interrupts when the sweep mode is set for line or external trigger operations.

6E-4 A24 GPIB PCB, GENERAL DESCRIPTION

The A24 GPIB PCB has its own microprocessor for interfacing the IEEE-488 instrument bus with the A24 PCB main microprocessor. It also contains a GPIB microprocessor and the necessary ROM and RAM for its operation.

GPIB Processor U7 controls the U5 and U6 bus transceivers. U7 is in turn controlled by U1, an 8085 8-bit microprocessor. U1 implements GPIB subset functions SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, and C5. The interface between U1 and U7 is via interrupts. The bus transfer rate is approximately 15 Kbytes/second. U7 receives commands from the IEEE-488 bus and sends them to a part of RAM used as a buffer. U1 then decodes these commands and sends the information to another part of RAM used as an output buffer. From here they go through U12 and U16 to the A23 PCB main microprocessor.

Microprocessor U1 has its own clock generator controlled by a 6 MHz crystal. Its program is located in EPROM U10. U11, an 8K RAM, acts as an input/output buffer and general scratch-pad RAM. U8 separates the address information from the multiplexed data-address bus of the 8085.

U4 and the GPIB interrupt from U12 control the transfer of data between the 8085 and the A23 (main) Microprocessor PCB.

For fast frequency stepping, an LFF interrupt is provided by the FF Int(terrupt) Logic circuit comprised of U9, U3, U13, and U17. First during its operation, up to 512 frequencies are loaded into the main microprocessor RAM (look-up table) from the GPIB. Then, each time a GET command is received from the GPIB, a LFF interrupt goes to the A23 Microprocessor PCB. When the main microprocessor receives this interrupt, it knows to go to a new frequency (which is stored in the look-up table) and executes the commands to perform the operation.

At turn-on, the main microprocessor tells the GPIB microprocessor to perform a self test. The GPIB then performs this self test on the circuits located on the A24 PCB and provides the results in a buffer in RAM. When the main microprocessor has completed its self test routines, it comes back and gets the results of the GPIB self test.

U14 is a parallel peripheral driver/receiver intended for future use.

The front panel GPIB status LEDs (remote, SRQ, listen, talk, etc.) are controlled by the main microprocessor from information supplied by the GPIB processor.

6E-5 A8 SERIAL I/O PCB, GENERAL DESCRIPTION

The A8 PCB, shown in the Figure 6E-3 block diagram, converts the 8-bit parallel data from the microprocessor data bus to a 16-bit serial format. It transmits this data to the A2, A6, A11, and A13 PCBs. It receives information from the A2, A14, and A7 PCBs. The A8 PCB is addressed through Port Decoder (processor address decoder) U1.

6E-5.1 Transmitting data

The microprocessor first loads data to the U5 multiplex (mux) latch. This latch selects which PCB will receive the data. The microprocessor then loads two 8-bit words into shift registers U9 and U11. When U11 finishes loading, it sets the U7 clock timer to start clocking data out at a rate of approximately 400 kHz. The parallel data in shift registers U9 and U11 is routed to the appropriate PCB via the U6 data mux. The clock is routed to that same PCB through clock mux U12. The clock synchronizes the receiving PCB circuits with the data transfer rate.

After 32 clock cycles, 16 bits of data have been transmitted and the timer disables the clock generator. In the case of the A2 Front Panel Control PCB, the timer also sends a strobe to latch data into the A2 PCB latches.

6E-5.2 Receiving data

When any key is pressed on the front panel, the A2 PCB sends an interrupt to the A23 Microprocessor PCB. Upon servicing the interrupt, the microprocessor sets the U10 serial input mux to switch the front panel data into U11 and clock mux U12 to route the clock to the front panel. It then triggers clock timer U7/U8 to shift the data first into U11 and then from U11 to U9. After the data has been shifted into U9, the microprocessor interprets and processes the keystroke.

In the case of the external reference detector signal input (**EXT REF DET**), the state of the line is read by the microprocessor (about every 50 ms) during housekeeping. In this case, the clock signal is used only on the A8 PCB to shift the data into the shift registers, it does not go through the clock mutiplexer.

6E-5.3 Ground Return Mux

The transformers following shift register U9 and clock timer U7/U8 (strobe and clock) couple the high frequency components of their output square waves into ground return mux FETs Q2-Q6. Since these square waves go through a filter network (chassis-mounted filtercon) having a capacitor to ground, current spikes often result. The transformers couple the high frequency components of equal magnitude but opposite polarity back into the ground system to cancel these spikes.

6E-5.4 U4 Fine Loop Flip-Flop

U4 is a 1-bit latch that provides the additional 17th bit required for the frequency dividers on the A11 Fine Loop Divider PCB. (The serial-data bus is only a 16-bit bus.)

6E-6 A8 SERIAL I/O PCB, DETAILED CIRCUIT DESCRIPTION

6E-6.1 Microprocessor Interface

The microprocessor data bus from A24 PCB goes to U5, U9, and U11. U5 is an 8-bit data latch for controlling the path of the serial data, U9 is a read/write shift register for sending and receiving serial data, and U11 is a write-only shift register for sending serial data. Since the serial I/O always sends or receives data in 16-bit segments, two shift registers are required, however, when receiving serial data, the microprocessor only uses 8 bits of data. This is why there is only one read shift register.

The A8 PCB is addressed by the **PA0-PA2** (Processor Address) lines and the **LPA22** (Low Processor Address) line. The **PA0-PA2** lines are common to all PCBs that the microprocessor sends data to, however, the **LPA22** line goes only to the A8 Serial I/O PCB. These address lines are decoded by U1 3-to-8 decoder. Only one of the outputs of U1 will be active low at any time. The pulses out of U1 are also only about 800 ns wide. These outputs from the decoder are normally referred to as a "strobe" as they normally are used only to latch data into a data latch or start and stop some function.

6E-6.2 Clock Timer

U7 is a free running oscillator at about 600 kHz and is controlled by the state of flip flop U4B. R6, R7, and C9 control the frequency of the signal from U1. When the processor wants to read or write to the A8 Serial I/O PCB, it first loads data into the data latches, and then clocks U4B with a strobe from U1-14 to start the clock. This strobe also latches the final data into U11 and resets the U8 counter. U4B-9 goes high and U7 oscillates at 600 kHz. The output of U7 is divided by two to get a 50% duty cycle; it clocks the U9 and U11 shift registers via U2C.

At U8-6, the 600 kHz is divided by 16 and goes to U8-13 where it is divided by 2. The signal at U8-10 goes to U2 where it is inverted. It then goes to U4B and clears (sets pin 9 to 0) the flip-flop that turns the U7 clock oscillator off after 32 cycles have occurred. Figure 6E-1 illustrates the clock timing sequence for a serial read or write.

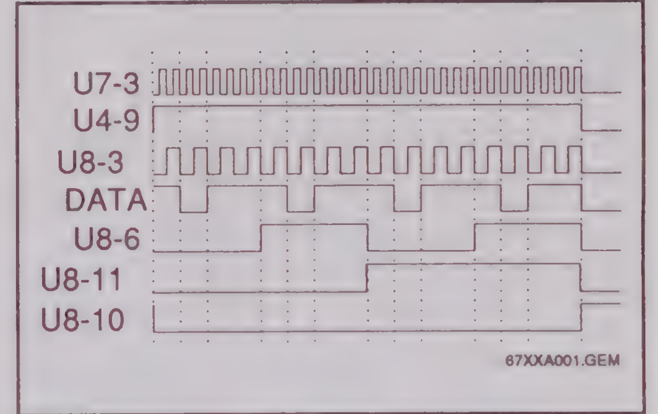


Figure 6E-1. Serial I/O Data Transfer Timing

U3A reads the output (busy bit) of U4 which tells the microprocessor if the serial I/O is in the process of converting serial data to parallel data or parallel data to serial data. When U3-1 is set low by the U1 decoder, the state of U4B is placed on **D0** of the data bus where its status is read by the processor.

6E-6.3 Shift Registers

At the same time flip-flop U4B is strobed, pin 1 of U11 is strobed; this loads any data on the data bus into its registers. On the rising edge of each clock, the data in this register is shifted 1 bit toward the output at pin 9. At the same time, data on pin 10 is shifted into the registers, replacing the data that was previously in the register.

Previous to U11 being loaded with parallel data, U9 is loaded when U1-12 goes low. At the same time U11 is clocked, U9 is clocked; this shifts the latched data to U9-17 output – 1 bit for each clock cycle. At the same time data is being shifted out on U9-17, data from from U11-9 is being shifted into U9-11. This continues until all 16 bits stored in U9 and U11 are shifted to the output of U9.

6E-6.4 Multiplexers

At the same time data is shifted out of the shift registers on the A8 PCB, it is being shifted into registers on the destination PCB. The path that the data and clock signals take is determined by the U6 and U12 multiplexers which are themselves controlled by data latch U5. If, for example, the data is destined for the A6 Coarse Loop Divider PCB, the address inputs on U6 pins 1, 15, and 16 will route the signal pin 8 to pin 5. At the same time, the address inputs on U12 pins 1, 15, and 16 will route the clock signal to the A6 Coarse Loop Divider PCB.

Since the A1 and A2 front panel PCBs have more latches than 16 bits of data can handle, a front panel strobe is provided by multiplexer U10. This strobe is the same signal that resets the U4B clock control flip-flop. In this case, 8 bits of the data going to the front panel contain the actual data to be sent to the front panel latches, and the other 8 bits of data contain the address information for the data latch where this data is to be latched. The 8 bits of data and 8 bits of address information is loaded into two shift registers on the A2 Front Panel Control PCB. The shift register for the 8 bits of data is tied to an internal parallel 8 bit data bus. The shift register for the address information is tied to some address decoders. Once the data and address information has been shifted into the registers, the strobe at U10-5 will go low and latch the data into the addressed data latch.

6E-6.5 Ground Return Multiplexer

All of the serial data and clock signals go to destinations which have chassis-mounted filtercons as an interconnection device. The filtercons are a π-filter network with approximately 1500 pF of capacitance to ground. These are used for the signal and power supply lines for the phase lock circuits and front panel circuits. These filter networks reduce crosstalk between the circuits in the RF casting and prevent their RF signals from radiating from the 67XXA (for EMC – Electro-Magnetic Compatibility considerations).

Driving the capacitance of the filtercons with TTL signals causes high frequency ground currents that can not only affect other circuits connected to the ground, but also cause undesireable radiation of the signals; this also degrades the EMC performance of the instrument. T1 thru T4 couple these high frequency TTL signal components to a multiplexer consisting of Q2 thru Q6. These transistors are low resistance (less than 5 Ohms) FET switches controlled by data latch U5. The inverted high frequency components are coupled back into the grounding system to oppose the currents caused by the filtercons, thereby reducing the overall ground current effects and improving EMC performance.

6E-6.6 Serial Data Input

When any key on the front panel is pressed, an interrupt is sent to the microprocessor. The key code is loaded into a shift register on the A2 Front Panel Control PCB at the same time. The microprocessor sets data latch U5 to enable the U10B **FP DATA** (front panel data) path and the U12 **FP CLK** (front panel clock) path. It then starts the U7 clock oscillator which shifts the data from the front panel shift register into register U11 and then register U9. Upon completion of the conversion cycle, the processor strobes U9 to place the data in its registers on the data bus via U1-15 strobe.

6E-6.7 External Reference Detected Signal Input

If an external 10 MHz reference signal is applied to the 67XXA rear panel 10 MHz REF INPUT BNC connector, the A7 Reference Divider PCB causes the **EXT REF DET** line to go to TTL high. During housekeeping, the state of this line is read by the microprocessor via U10-11 on the A8 Serial I/O PCB. In this case, the clock signal will not be sent from U12 to the other PCBs on the serial data bus. Only the 1 bit will be shifted to the **D0** line by the 16 clock cycles.

6E-6.8 Fine Loop Data (FLD12) Latch

U4A is a D-type flip-flop used as a 1 bit data latch. The data on **D0** is set for the desired state, then the U1-10 strobe clocks this data to the output on U4A-5 where it goes to the A11 Fine Loop Divider PCB (the fine loop dividers need 17 bits of information). **FLD12** goes high only when the frequency of the fine loop equals 300 MHz.

6E-7 DIGITAL CONTROL ASSEMBLIES, TROUBLESHOOTING

Digital control assembly troubleshooting is covered entirely in Table 6E-2.

6E-8 DIGITAL CONTROL ASSEMBLIES, SERVICE SHEETS

Table 6E-1 on the first page of this section presents the arrangement of the block diagram, schematics, and parts locater diagrams for the A8 PCB, the A23 PCB, and the A24 PCB.

Table 6E-2. Digital Control Troubleshooting (1 of 7)

Trouble / Error Code	Troubleshooting Procedure
	General Digital Control Assemblies Troubleshooting
Preliminary Checks at Power On	In normal operation, at turn on the following occurs: 1) The front panel LCDs and LEDs light in a random pattern for a few seconds, then blank while self test runs; 2) After self test finishes, the front panel displays the set-up that was present when instrument power was last turned off. If the LCDs and LEDs don't change from their initial random pattern and the front panel controls are inoperative, the problem lies in either the Digital Control assemblies or the Front Panel assemblies (section 6D). Observe the rear panel HORIZ OUT signal with an oscilloscope or the RF OUTPUT with a frequency counter. If the 67XXA sweeps or there is a phase locked RF signal from the RF OUTPUT, the A23 Microprocessor PCB is operating. Go to the A8 Serial I/O PCB troubleshooting below. • If the 67XXA is not sweeping or there is no phase locked RF OUTPUT, the A23 PCB or A24 PCB is faulty. To verify, observe the signal at XA17-13. You should see 800 ns TTL pulses occuring about every 50 ms; this indicates that the microprocessor is performing its housekeeping routines. The A23 PCB is not likely to be causing the problem. Proceed to A8 Serial I/O PCB troubleshooting below. • If no pulses are observed at XA17-13, turn the unit off and remove the A24 GPIB PCB. Turn the power back on. • If the unit returns to normal operation, then go to the A24 GPIB PCB troubleshooting in this table. NOTE Without A24 being installed, E24-0 error code will display during power up self test. The response to the operation of the front panel will be somewhat slower. • If the unit still does not resume normal operation go to the A23 Microprocessor PCB troubleshooting in this table.
	A8 Serial I/O PCB Troubleshooting
	One of the easiest ways to observe the signal from and to the A8 board is to set the 67XXA for a full-band step sweep. This will cause the A8 PCB to write data to every PCB on the serial bus. Syncronize an oscilloscope to U2-8 signals and observe the clock pulses and data pulses to each device as the 67XXA writes to each PCB. If you are interested in looking at one output in particular, set up the front panel for an operation that will address that particular board. Examples are given below.
A6 Coarse Loop Divider Write Data Test	**<Shift> TRIGGER 012** allows you to increment and decrement the frequency of the A4 Coarse Loop Oscillator which require a write to the A6 Coarse Loop Divider PCB.
A11 Fine Loop Divider Write Data Test	**<Shift> TRIGGER 011** allows you to increment and decrement the frequency of the A9 Fine Loop Oscillator which require a write to the A11 Fine Loop Divider PCB. **FLD12** at A8-40 goes high at any Fine Loop frequency of 300 MHz or above.

Table 6E-2. Digital Control Troubleshooting (2 of 7)

Trouble / Error Code	Troubleshooting Procedure
	A8 Serial I/O PCB Troubleshooting (Continued)
A13 Pulse Generator Write Data Test	**SHIFT, PULSE WIDTH** allows you to increment and decrement the pulse width requiring a write to the A13 Board.
A2 Front Panel Control Write Data Test	Going to an analog or step sweep mode causes a continuous write to the front panel to update the SWEEP LED. Pressing CW SELECT continuously sends an interrupt the the A23 Microprocessor and causes it to read the keycode from the front panel assemblies. In CW mode, with no keys pressed, you should get a read about every 50 ms as the microprocessor reads the status of the external reference detector **EXT REF DET**. • Any individual PCB not getting a data or clock signal indicates that the U5 data latch has a defective bit. • If any PCB is getting a data signal but no clock signal, it indicates that U12 is defective. • If a PCBis getting a clock signal but no data signal, it indicates that U6 is defective. • No front panel strobe indicates a defective U10. • No clock output from U7 indicates either a defective U7, U4B, or U1. • An incorrect number of clock cycles indicates a defective U8 or U2 (see Figure 6E-1).

E8-10

To troubleshoot the A8 Serial I/O PCB, the A23 Microprocessor and A24 GPIB PCBs must be operating. The following procedure assumes that control of front panel has been lost because of an inoperative A8 PCB. This procedure uses a GPIB controller to control the 67XXA.

- Connect the GPIB controller. Write a program to put the 6700A in a loop that will constantly exercise the A8 Serial I/O. The following program, written for a Wiltron 85 controller, will provide this control.

```
10 OUTPUT 705;"F1 GH F2 GH"
20 OUTPUT 705;"CF1 SQP"
30 WAIT 5
40 OUTPUT 705;"CF2 SQP"
50 WAIT 5
60 GOTO 20
```

  The above program alternates between F1 and F2 with a 1 kHz square wave at the F1 frequency. This requires serial data to be sent to the following PCBs: A2 Front Panel Control, A6 Coarse Loop Divider, A11 Fine Loop Divider, and A13 Pulse Generator.

- Monitor the test points shown below with an an oscilloscope. You should see a 32-cycle burst of square wave clock pulses each time the A23 Microprocessor writes to the PCB. The internal PRF of this burst will be approximately 200 kHz.

  Test Points:
  XA8-26 Front Panel Clock **(FP CLK)**
  XA8-39 Fine Loop Clock (**FL CLK**)
  XA8-36 Coarse Loop Clock (**CL CLK**)
  XA8-34 Pulse Trigger Clock (**PLS TRIG CLK**)
  XA8-31 Pulse Generator Clock (**PG CLK**)

  If any one of these signal are missing, it indicates a defective A8U12 multiplexer or A8U5 data latch.

  If all of these signals are missing, it indicates that the timer—composed of A8U4, A8U3, A8U7, A8U8, and A8U2—or the A8U1 address decoder is defective.

Table 6E-2. Digital Control Troubleshooting (3 of 7)

Trouble / Error Code	Troubleshooting Procedure
	A8 Serial I/O PCB Troubleshooting (Continued)
Serial Data Output Checks	The following procedure checks the serial data output to the PCBs. It assumes that the clock signals checked previously are proper. Monitor each of the test points shown below with an oscilloscope (with the previous GPIB program running). At each test point, you should see 16 bits, either 1's or 0's, at approximately a 100 kHz rate. (This rate occurs as it takes 2 clock cycles for each data bit.) Test Points: XA8-25 Front Panel Data (**FP DATA**) XA8-37 Fine Loop Data (**FL DATA**) XA8-33 Coarse Loop Data (**CL DATA**) XA8-30 Pulse Generator Data (**PG DATA**) Pulse Generator data is transmitted during both Pulse Trigger Clock and Pulse Generator Clock cycles. The following assumes that data is present; that is, that the pulse train is changing from 1's to 0's at some random rate. • If only some of the test points have no data being transmitted, the A8U6 multiplexer is defective. • If all of the data signals are missing, shift registers A8U9 or A8U11 are likely suspects. • If the first half of the 16-bit data stream is always the same on each data line, it indicates a defective A8U9. • If the second half of the 16-bit data stream is always the same on each data line, it means A8U11 is defective.
FLD12 Check	The **FLD12** data line at XA8-40 may be checked as follows. • Disable above the GPIB program. Press SHIFT, TRIGGER, 011. This lets you tune the Fine Loop oscillator with the front panel keypad. • Monitor XA8-40. At any frequency below 300 MHz, it should be TTL low. At any frequency 300 MHz and above, the level should be TTL high. • If **FLD12** is not switching as mentioned above, A8U4 is defective. • Although the front panel may be receiving the proper clock and data signal, it also requires a strobe to latch this data into the latches on the A2 PCB. Monitor this strobe at XA8-29 with an oscilloscope. During the final clock cycle of the 32 bit clock stream to the front panel, you should see a 5 μs wide pulse. If this pulse is not observed, the A8U10 multiplexer is defective. • If the front panel displays indicate the front panel setup but the 67XXA will not respond to the keypad input, there is a problem in either the Front Panel assemblies or the A8 Serial I/O receiving system.To check this, monitor A28J1-7 with an oscilloscope. Each time a key is pressed, this line, **KEYPAD INT**, should go to a TTL high. If this does not happen, refer to section 6D, Front Panel Troubleshooting. • If the front panel is sending the interrupt, monitor XA8-26. When you press a front panel key you should see a 32-cycle clock stream at this point. • If this signal is not present, refer to section 6D, Front Panel Troubleshooting. • If this signal is present, monitor XA28-28 with an oscilloscope. When you press a front panel key, you should see a serial data stream. This indicates that the front panel is sending the data. If there is a data stream, A8U10 or A8U2 is defective. If there is no data stream, refer to section 6D, Front Panel Troubleshooting.

Table 6E-2. Digital Control Troubleshooting (4 of 7)

Trouble / Error Code	Troubleshooting Procedure
	A23 Microprocessor PCB Troubleshooting
E23-10	This error code indicates that A23U25 has failed a read/write test. If the data here is corrupted, it can lead to very erratic front panel displays and instrument operation. This is because the front panel setups are stored here when the instrument is turned off. • Replace A23U25. • Perform a **master reset** as follows: With the 67XXA in STANDBY, press and hold the RF ON/RF OFF key. Press the STANDBY/ON key to turn the instrument on. After the displays blank and the self test has started, release the RF ON/RF OFF key. An E8-10 error will occur. This procedure overwrites all information stored in the non-volatile RAM, including the 9 stored front panel setups with their default values. (Note: depressing the RESET key overwrites only the front panel setup that was present after instrument turn on.)
E23-11	This error code indicates that A23U26 has failed the read/write test. • Replace A23U26. Since false information in the volatile RAM can lead to unpredicable operation, a master reset should be done to eliminate the possibility of corrupted data in non-volatile RAM caused by a defective A23U26; see E23-10 above.
E23-12	This error code indicates A23U29 has failed the read/write test. • Replace A23U29. Since false information in the volatile ram can lead to unpredicable operation, a master reset should be done to eliminate the possibility of corrupted data in non-volatile RAM caused by a defective A23U29; see E23-10 above.
E23-14	This error code indicates A23U24 Personality PROM data is corrupted, which can lead to very erratic instrument operation. • Replace A23U24 with an EPROM having the same options and version number as the defective unit. Perform a master reset as described in E23-10 above to eliminate the possibility of corrupted data in non-volatile RAM caused by a defective A23U24. If A23U24 is not available with the same version number as the old EPROM, or if the firmware is to be updated with a new version, A23U24, A23U22, and A23U23 must be replaced as a set. After replacing these EPROMs, perform the following procedure: • Perform a master reset as described in E23-10 above. • On the A23 PCB, move the CAL/NORMAL jumper from the NORM to the CAL position (do not turn the unit off). • Press <Shift> TRIGGER 097. This performs a check-sum and stores the results in non-volatile RAM. • Move the CAL/NORMAL jumper from the CAL position to the NORM position. • Press SELF TEST. If the self test routine results display error codes, refer to the appropriate error code action (see section 6C Error Code Summary table).

Table 6E-2. Digital Control Troubleshooting (5 of 7)

Trouble / Error Code	Troubleshooting Procedure
	A23 Microprocessor PCB Troubleshooting (Continued)
E23-15	This error code indicates the the A23U22 EEPROM data is corrupted. This can lead to very erratic instrument operation. • Replace A23U22 with an EPROM having the same options and version number as the defective unit. Perform a master reset (see E23-10) to eliminate the possibility of corrupted data in non-volatile RAM caused by a defective A23U22. If A23U22 is not available with the same version number as the old EPROM, or if the firmware is to be updated with a new version, A23U24, A23U22, and A23U23 must be replaced as a set. After replacing these EPROMs, perform the following procedure: • Perform a master reset as described in E23-10 above • On the A23 PCB, move the CAL/NORMAL jumper from the NORM to the CAL position (do not turn the unit off). • Press <Shift> TRIGGER 089, then <Shift> TRIGGER 397. This performs a check-sum and stores the results in non-volatile RAM. • Move the CAL/NORMAL jumper from the CAL position to the NORM position. • Press SELF TEST. If the self test routine results display error codes, refer to the appropriate error code action (see section 6C Error Code Summary table).
E23-16	This error code indicates that A23U23 EEPROM data is corrupted. This can lead to very erratic instrument operation. • Replace A23U23 with an EPROM having the same options and version number as the defective unit. Perform a master reset (see E23-10) to eliminate the possibility of corrupted data in non-volatile RAM caused by a defective A23U23. If A23U23 is not available with the same version number as the old EPROM, or if the firmware is to be updated with a new version, A23U24, A23U22, and A23U23 must be replaced as a set. After replacing these EPROMs, perform the following procedure. • Perform a master reset as described in E23-10 above • On the A23 PCB, move the CAL/NORMAL jumper from the NORM to the CAL position. • Press <Shift> TRIGGER 089, then <Shift> TRIGGER 397. This performs a check-sum and stores the results in non-volatile RAM. • Move the CAL/NORMAL jumper from the CAL position to the NORM position. • Press SELF TEST. If the self test routine results display error codes, refer to the appropriate error code action (see section 6C Error Code Summary table).
E23-17, E23-18, or E23-19	This error code indicates that an EPROM checksum error has occurred. Follow the E23-15 procedure.

Table 6E-2. Digital Control Troubleshooting (6 of 7)

Trouble / Error Code	Troubleshooting Procedure
	A23 Microprocessor PCB Troubleshooting (Continued)
E23-20	This error code indicates that the non-volatile RAM A23U25 is not holding the stored data when the instrument is turned off. However, it may still pass the E23-10 error code test. • Perform a master reset as described in E23-10 above • Press SELF TEST. • If E23-20 error code still remains, see the E23-10 error code procedure. • If the E23-20 error code is not displayed, set the unit to STANDBY and wait for a few minutes, then turn the unit back on. If the E23-20 error code returns during the self test, see the E23-10 error code procedure. • If the E23-20 error code is not displayed, the unit has returned to normal operation.
E23-21	This error code indicates that an I/O error has occurred. Check the I/O hardware circuits.
E23-22	This error code indicates that the A23 PCB is inoperative and will not initialize or perform the self test routine. • Monitor A23TP4 with an oscilloscope. You should see TTL signals at approximately a 5 MHz rate. This indicates that the microprocessor is operating. • If the signal at A23TP4 is not as it should be, check A23U1-11 for a TTL high. If this signal is 0V, the A23U32 circuit is defective. • If the signal at A23U1-11 is a TTL high, A23U1 is most likely defective. • If the microprocessor appears to be operating, replace A23U22, A23U23, and A23U24 and perform the procedures under E23-14 error code troubleshooting. If the above procedures does not restore the A23 PCB to normal operation, perform the following procedure. • Remove the J1 jumper and set the A23 SERV\NORM (at U9) switch to SERV. This puts the microprocessor in a loop so that it toggles all data and address lines. • Check each of the data latches for a bit that is not toggling. Such a bit indicates a defective latch. • Replace the defective latch and perform the E23-14 troubleshooting procedure. **NOTE** Return the SERV/NORM switch to NORM after completing the troubleshooting procedures.

Table 6E-2. Digital Control Troubleshooting (7 of 7)

Trouble / Error Code	Troubleshooting Procedure
	A24 GPIB PCB Troubleshooting
E24-0	This error code indicates that the A24 PCB is not present or is not operational. If the A24 PCB is actually present, perform the following procedures. • Replace the A24U10 EPROM. • If the A24 PCB does not resume normal operation after replacing A24U10, set the A24 SERV/NORM switch to SERV and remove the A24J1 jumper. Check each address and data line to ensure that each is toggling. • If none of the data and address lines are active, replace A24U1. • If the data and address lines are active, check each data latch for a bit that is not active and replace the defective data latch. (See the E23-14 procedure for a test to determine whether a bit is active.) **NOTE** Return the SERV/NORM switch to NORM after completing the troubleshooting procedures. One of the GPIB indicator LEDs on the front panel is illuminated at all times even when the GPIB interface is not connected to a controller or when the 67XXA hangs up the GPIB bus. • Check each of the GPIB interface ICs, A23U5 and A23U6, for an inactive bit and replace either defective IC.

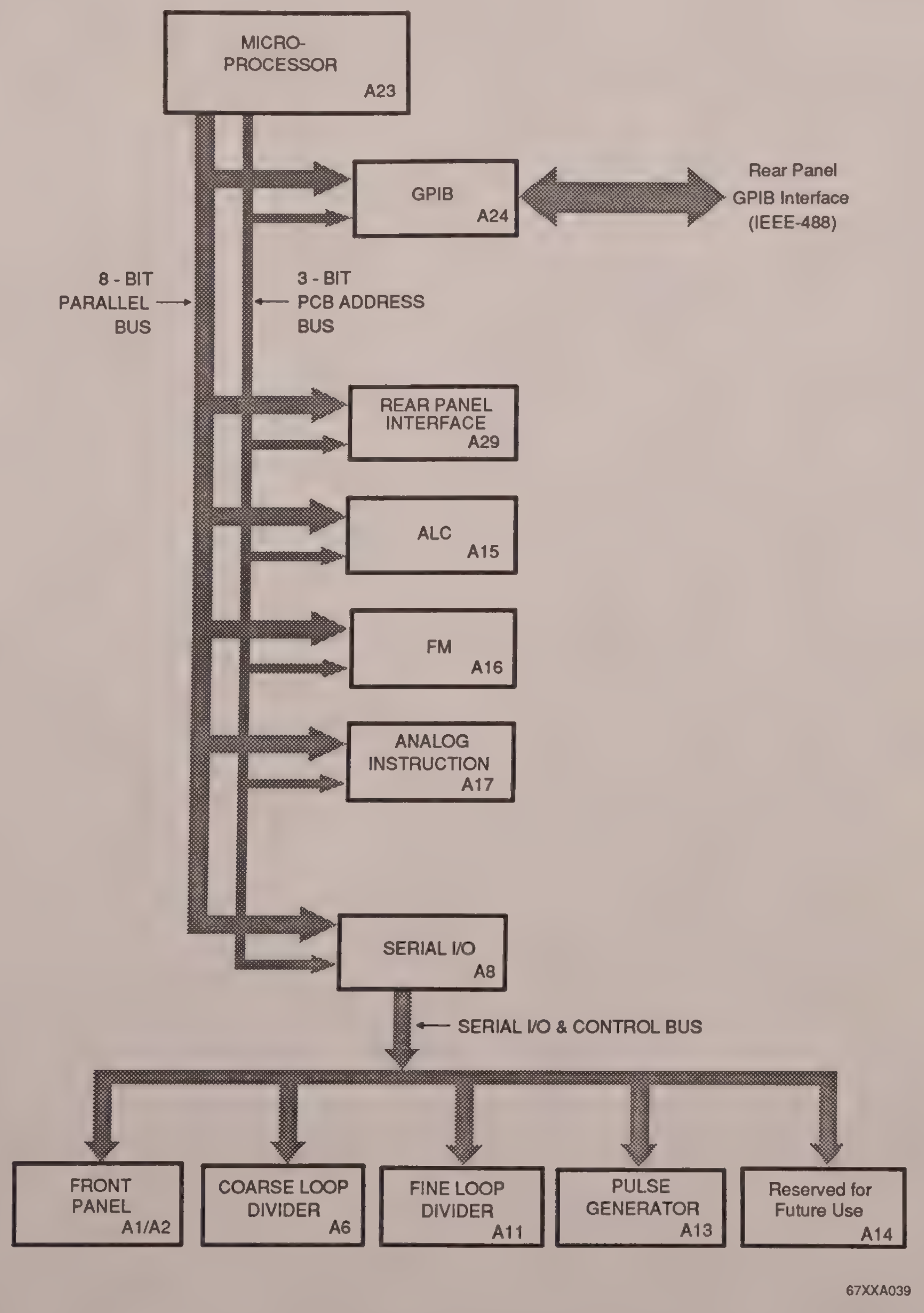

MICRO-PROCESSOR A23
GPIB A24
Rear Panel GPIB Interface (IEEE-488)
8 - BIT PARALLEL BUS
3 - BIT PCB ADDRESS BUS
REAR PANEL INTERFACE A29
ALC A15
FM A16
ANALOG INSTRUCTION A17
SERIAL I/O A8
SERIAL I/O & CONTROL BUS
FRONT PANEL A1/A2
COARSE LOOP DIVIDER A6
FINE LOOP DIVIDER A11
PULSE GENERATOR A13
Reserved for Future Use A14
67XXA039

Figure 6E-2. Digital Control Assemblies Overall Block Diagram

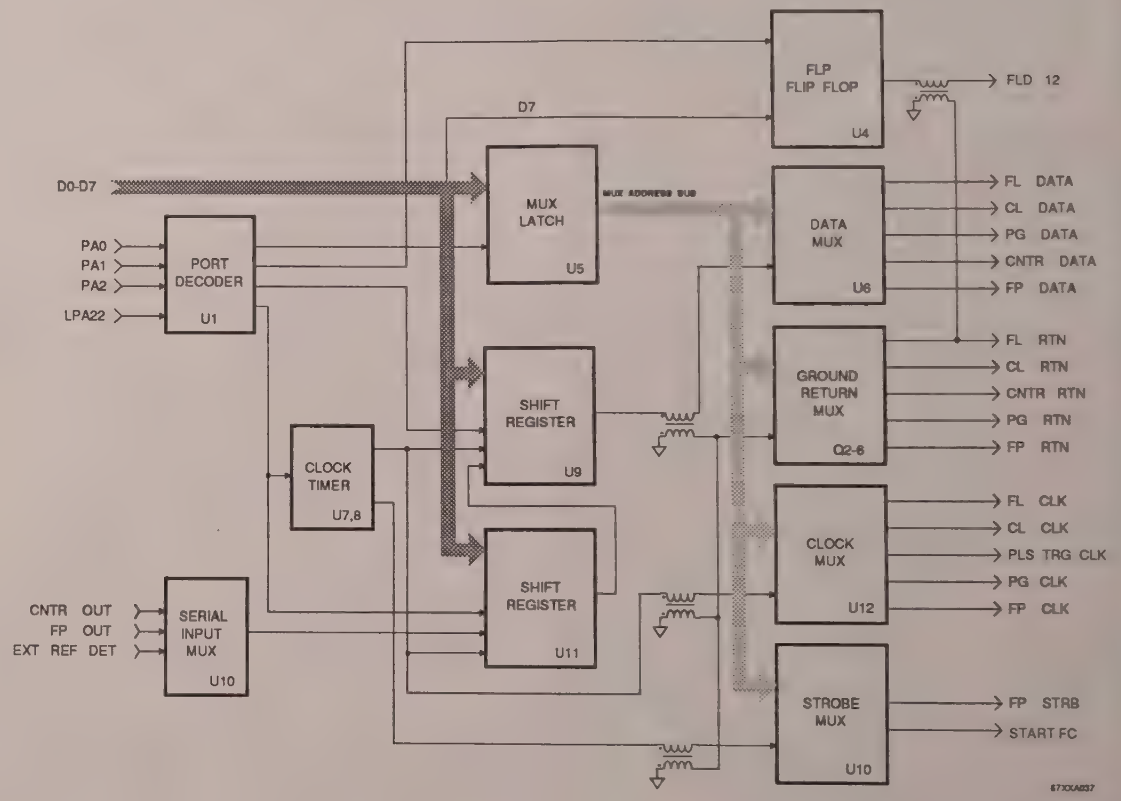

FLP FLIP FLOP U4
FLD 12
D7
D0-D7
MUX LATCH U5
MUX ADDRESS BUS
DATA MUX U6
FL DATA
CL DATA
PG DATA
CNTR DATA
FP DATA
PA0
PA1
PA2
LPA22
PORT DECODER U1
GROUND RETURN MUX Q2-6
FL RTN
CL RTN
CNTR RTN
PG RTN
FP RTN
SHIFT REGISTER U9
CLOCK TIMER U7,8
CLOCK MUX U12
FL CLK
CL CLK
PLS TRG CLK
PG CLK
FP CLK
CNTR OUT
FP OUT
EXT REF DET
SERIAL INPUT MUX U10
SHIFT REGISTER U11
STROBE MUX U10
FP STRB
START FC
67XXA037

Figure 6E-3. A8 Serial I/O PCB Block Diagram

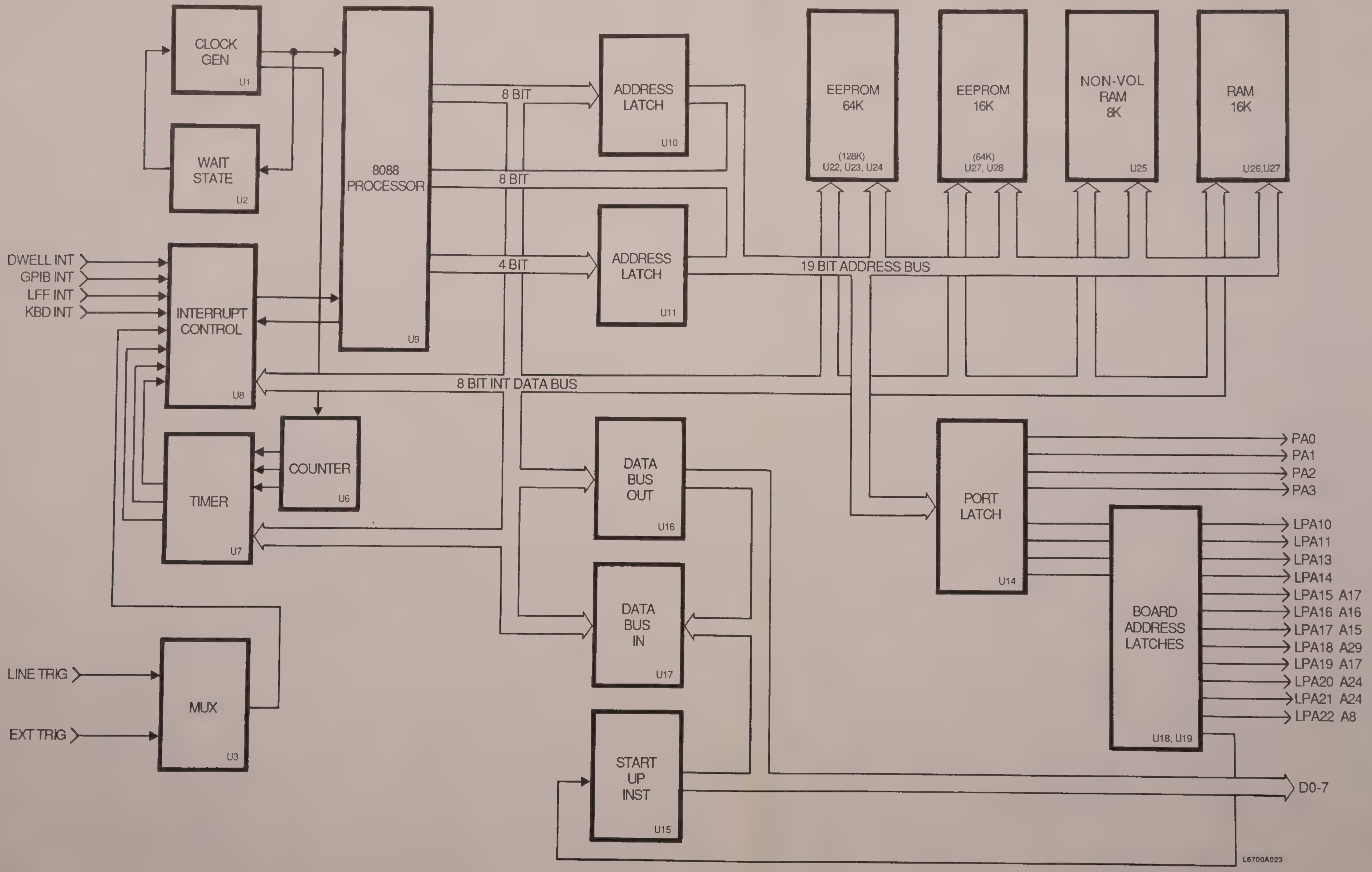

CLOCK GEN
U1
WAIT STATE
U2
8088 PROCESSOR
U9
8 BIT
8 BIT
4 BIT
ADDRESS LATCH
U10
ADDRESS LATCH
U11
EEPROM 64K
(128K)
U22, U23, U24
EEPROM 16K
(64K)
U27, U28
NON-VOL RAM 8K
U25
RAM 16K
U26,U27
19 BIT ADDRESS BUS
DWELL INT
GPIB INT
LFF INT
KBD INT
INTERRUPT CONTROL
U8
8 BIT INT DATA BUS
COUNTER
U6
TIMER
U7
DATA BUS OUT
U16
DATA BUS IN
U17
START UP INST
U15
PORT LATCH
U14
PA0
PA1
PA2
PA3
BOARD ADDRESS LATCHES
U18, U19
LPA10
LPA11
LPA13
LPA14
LPA15 A17
LPA16 A16
LPA17 A15
LPA18 A29
LPA19 A17
LPA20 A24
LPA21 A24
LPA22 A8
LINE TRIG
EXT TRIG
MUX
U3
D0-7
L6700A023

Figure 6E-4. A23 Microprocessor PCB Block Diagram

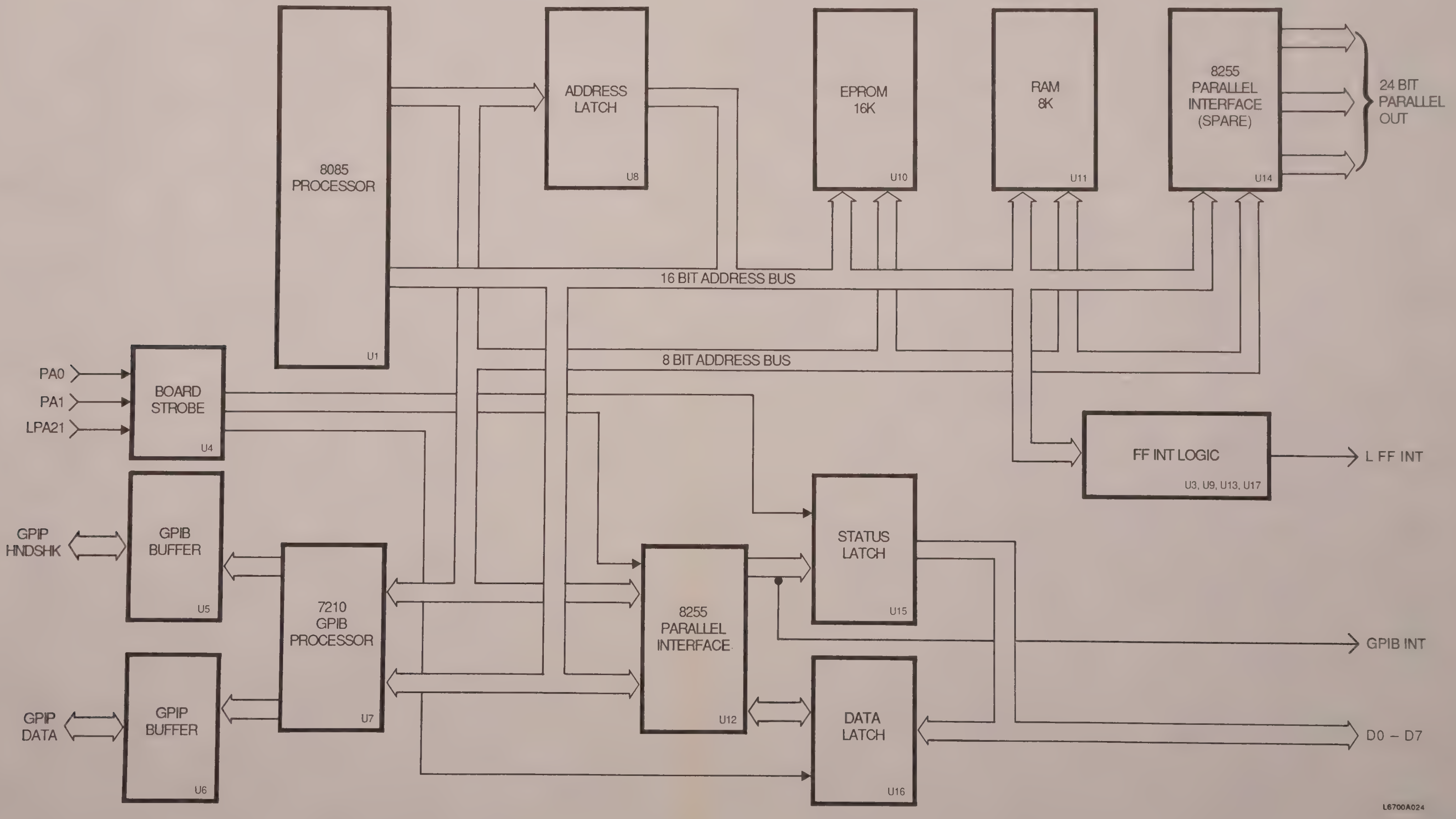
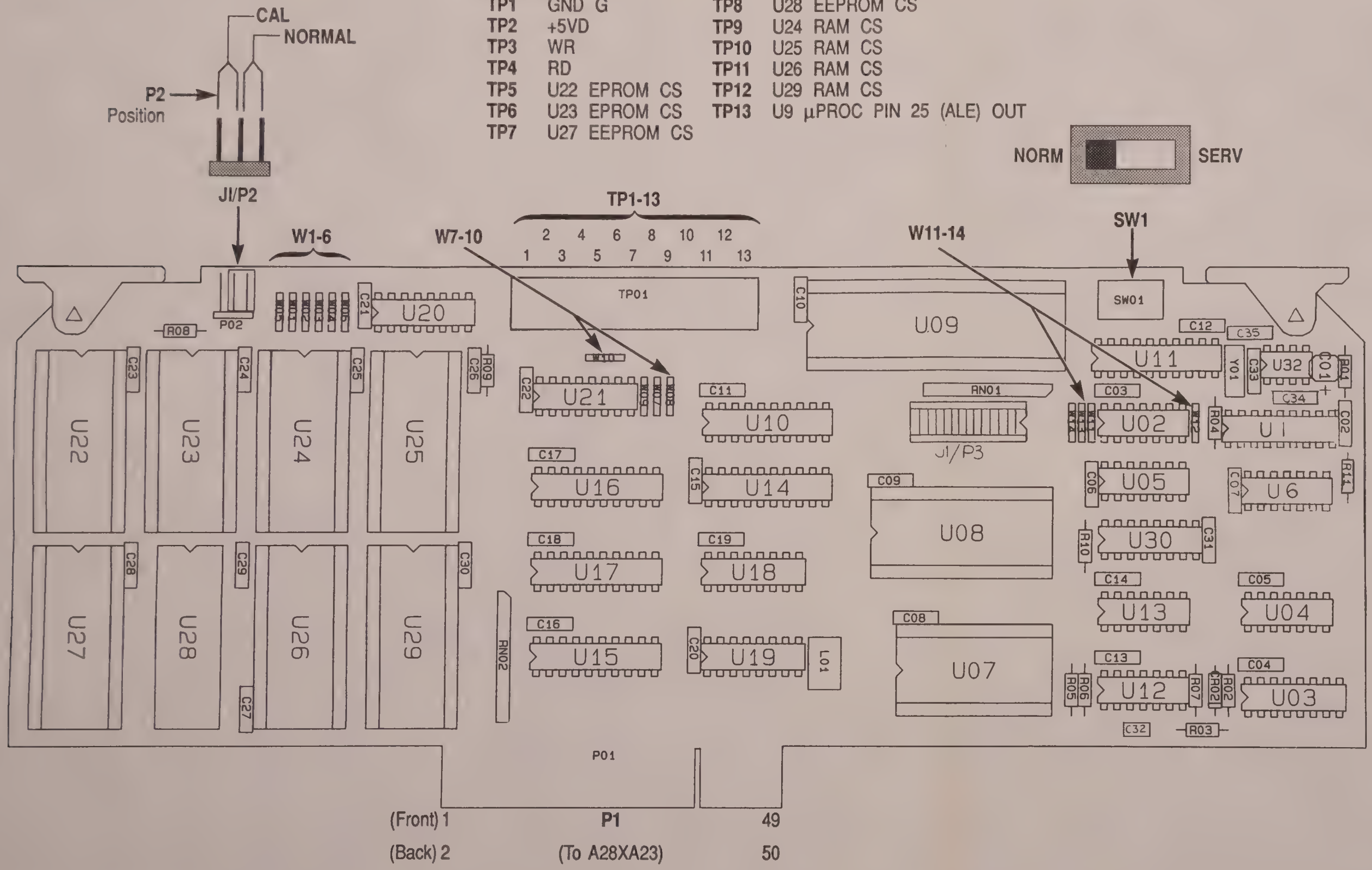
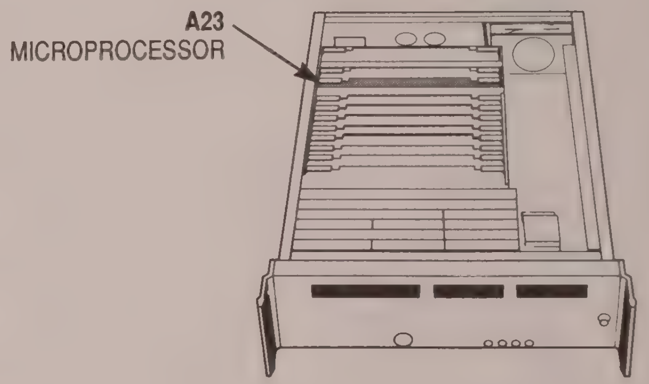

8085
PROCESSOR
U1
ADDRESS
LATCH
U8
EPROM
16K
U10
RAM
8K
U11
8255
PARALLEL
INTERFACE
(SPARE)
U14
24 BIT
PARALLEL
OUT
16 BIT ADDRESS BUS
8 BIT ADDRESS BUS
PA0
PA1
LPA21
BOARD
STROBE
U4
FF INT LOGIC
U3, U9, U13, U17
L FF INT
GPIP
HNDSHK
GPIB
BUFFER
U5
7210
GPIB
PROCESSOR
U7
8255
PARALLEL
INTERFACE
U12
STATUS
LATCH
U15
GPIB INT
GPIP
DATA
GPIP
BUFFER
U6
DATA
LATCH
U16
D0 – D7
L6700A024

Figure 6E-5. A24 GPIB PCB Block Diagram

TEST POINTS

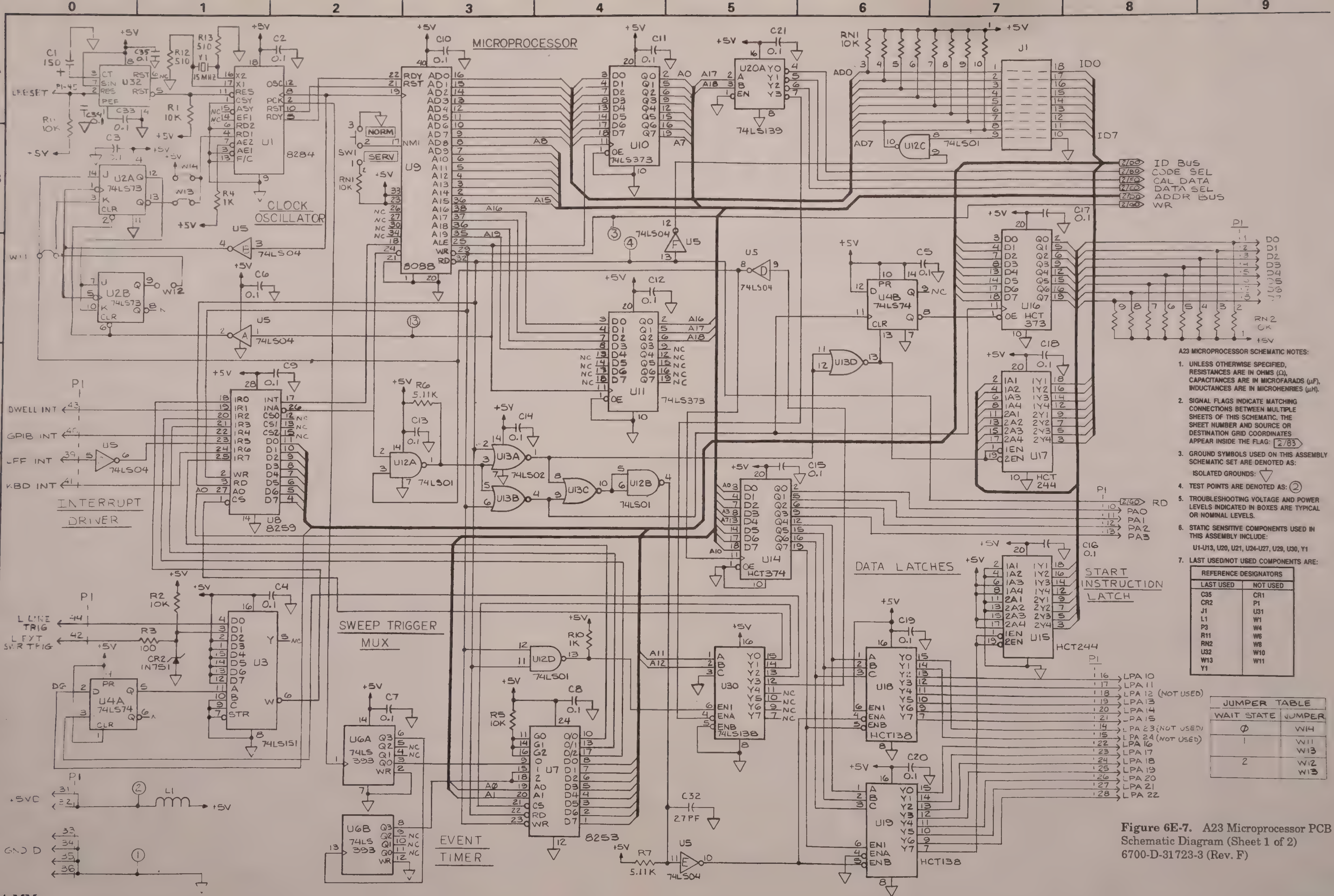
TP1	GND G	**TP8**	U28 EEPROM CS
TP2	+5VD	**TP9**	U24 RAM CS
TP3	WR	**TP10**	U25 RAM CS
TP4	RD	**TP11**	U26 RAM CS
TP5	U22 EPROM CS	**TP12**	U29 RAM CS
TP6	U23 EPROM CS	**TP13**	U9 µPROC PIN 25 (ALE) OUT
TP7	U27 EEPROM CS		


CAL
NORMAL
P2 Position
JI/P2
W1-6
W7-10
TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
W11-14
NORM
SERV
SW1
TP01
SW01
R08
P02
U20
C21
U09
C10
U22
U23
U24
U25
C23
C24
C25
C26
R09
W10
U21
C22
R09
W07
W08
C11
U10
RN01
J1/P3
C12
C35
U11
Y01
C33
U32
C01
R01
C03
U02
C34
R04
U1
C02
C17
U16
C15
U14
C09
U08
C06
U05
C07
U6
R11
C18
U17
C19
U18
R10
U30
C31
C28
C29
C30
U27
U28
U26
U29
RN02
C16
U15
C20
U19
L01
C08
U07
C14
U13
C05
U04
C13
U12
R05
R06
R07
R02
CR02
C04
U03
C32
R03
C27
P01
(Front) 1
(Back) 2
P1
(To A28XA23)
49
50


A23 MICROPROCESSOR

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6E-6. A23 Microprocessor PCB Parts Locater Diagram
6700-D-31723-3 (Rev. F)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
MICROPROCESSOR
CLOCK OSCILLATOR
INTERRUPT DRIVER
SWEEP TRIGGER MUX
EVENT TIMER
DATA LATCHES
START INSTRUCTION LATCH
U1 8284
U9 8088
U10 74LS373
U11 74LS373
U20A 74LS139
U32
U2A 74LS73
U2B 74LS73
U8 8259
U3 74LS151
U4A 74LS74
U4B 74LS74
U6A 74LS393
U6B 74LS393
U7 8253
U12A 74LS01
U12B 74LS01
U12C 74LS01
U12D 74LS01
U13A 74LS02
U13B
U13C
U13D
U14 HCT374
U15 HCT244
U16 HCT373
U17 HCT244
U18 HCT138
U19 HCT138
U30 74LS138
U5 74LS04
J1
P1
RN1 10K
RN2 CK
Y1 15MHZ
SW1 NORM SERV
LRESET
DWELL INT
GPIB INT
LFF INT
KBD INT
L LINE TRIG
L EXT SWR TRIG
+5VC
GND D
ID BUS
CODE SEL
CAL DATA
DATA SEL
ADDR BUS
WR
RD
PA0
PA1
PA2
PA3
D0
D1
D2
D3
D4
D5
D6
D7
LPA 10
LPA 11
LPA 12 (NOT USED)
LPA 13
LPA 14
LPA 15
LPA 23 (NOT USED)
LPA 24 (NOT USED)
LPA 16
LPA 17
LPA 18
LPA 19
LPA 20
LPA 21
LPA 22
+5V

A23 MICROPROCESSOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/83
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   ISOLATED GROUNDS: ▽
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   U1-U13, U20, U21, U24-U27, U29, U30, Y1
7. LAST USED/NOT USED COMPONENTS ARE:

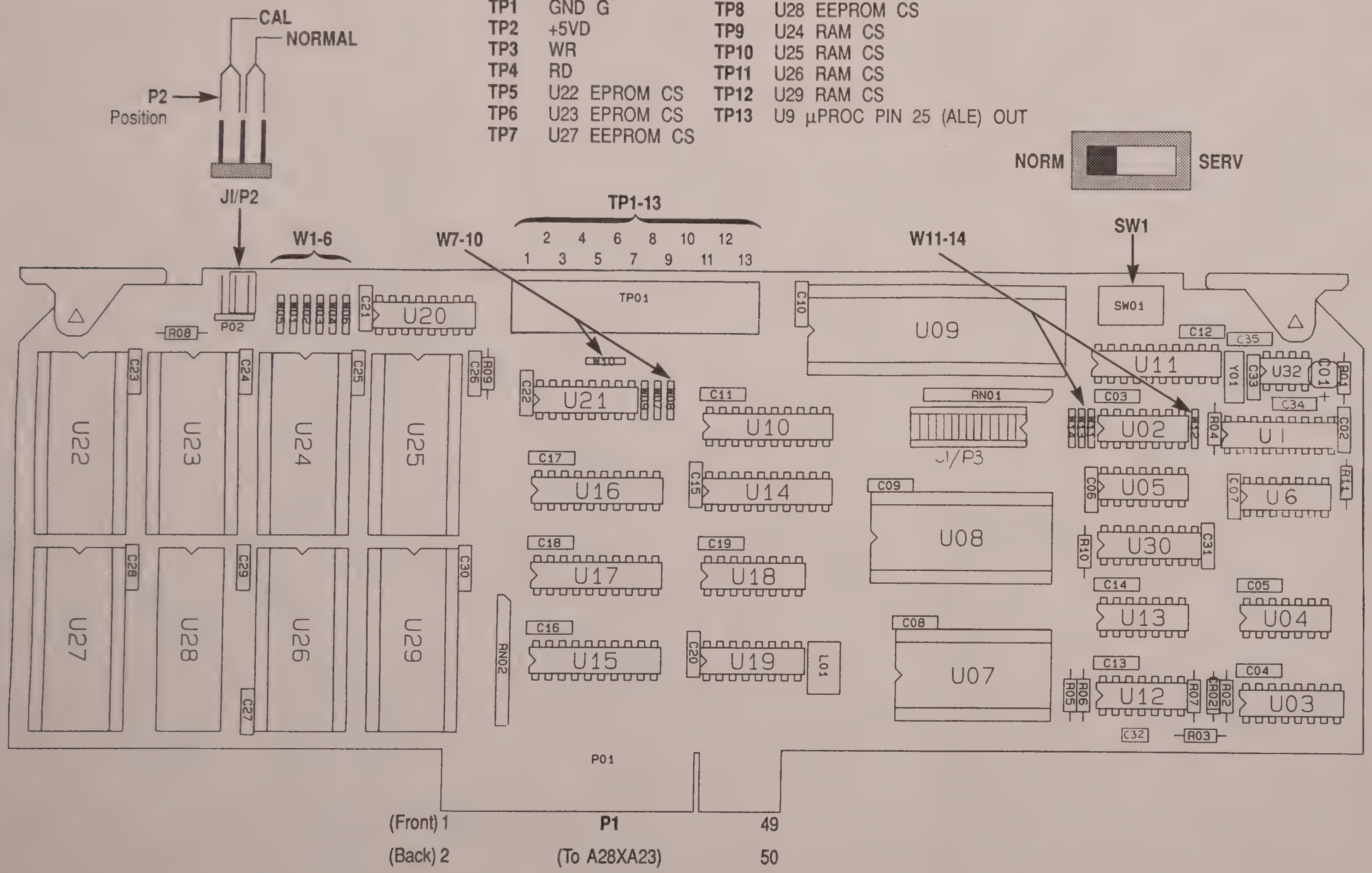
REFERENCE DESIGNATORS	
LAST USED	NOT USED
C35	CR1
CR2	P1
J1	U31
L1	W1
P3	W4
R11	W6
RN2	W8
U32	W10
W13	W11
Y1	

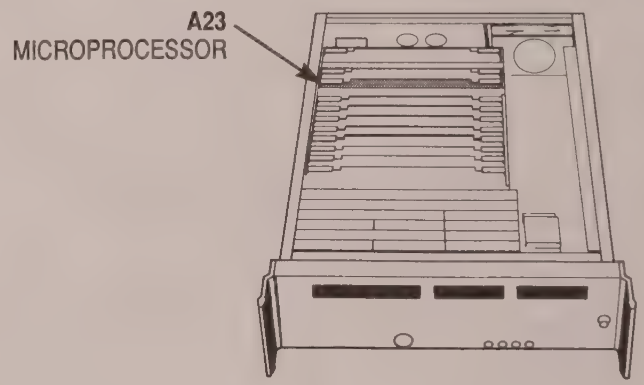
JUMPER TABLE	
WAIT STATE	JUMPER
Ø	W14
1	W11 W13
2	W12 W13

Figure 6E-7. A23 Microprocessor PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31723-3 (Rev. F)

TEST POINTS

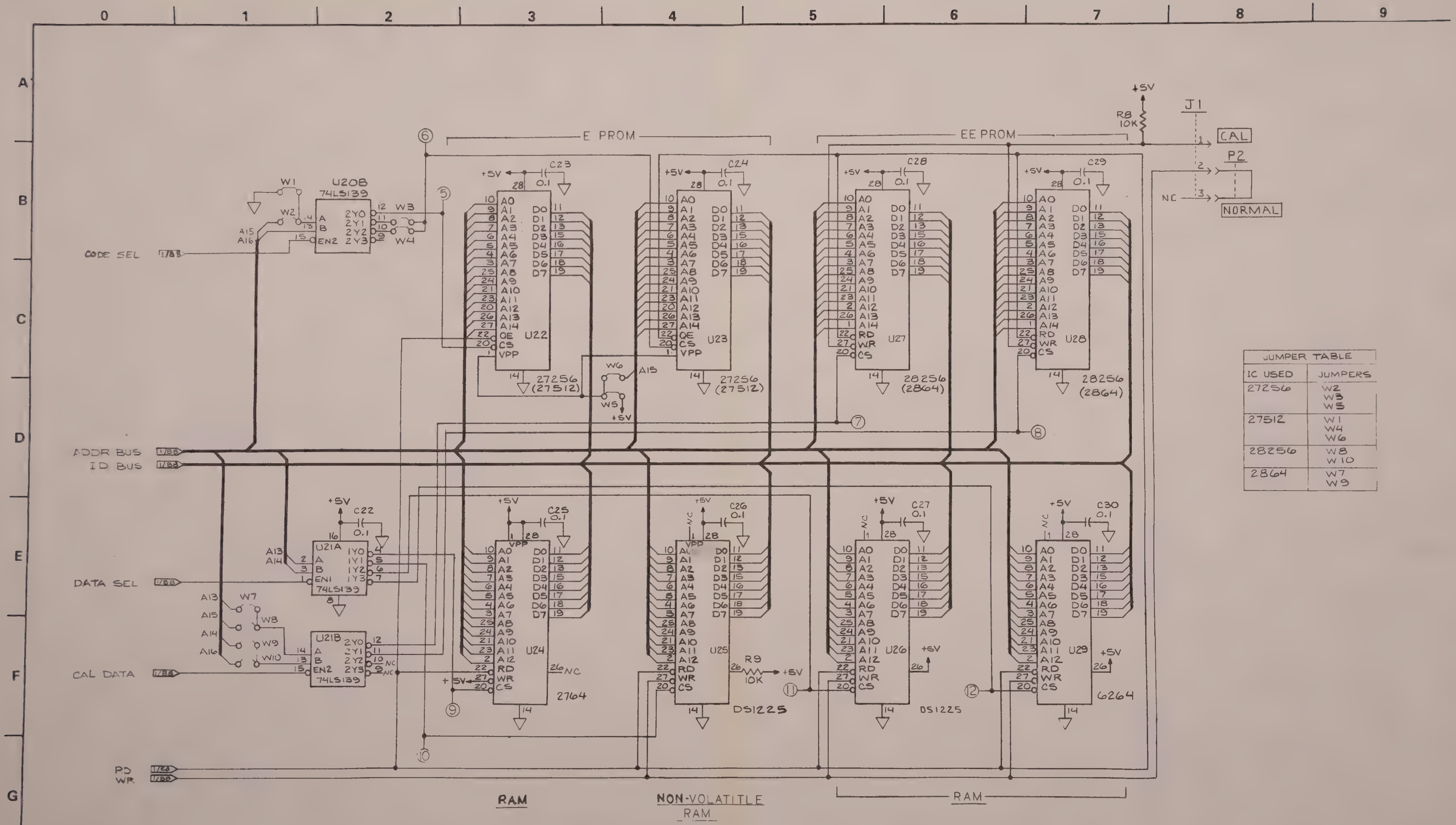
TP1	GND G	**TP8**	U28 EEPROM CS
TP2	+5VD	**TP9**	U24 RAM CS
TP3	WR	**TP10**	U25 RAM CS
TP4	RD	**TP11**	U26 RAM CS
TP5	U22 EPROM CS	**TP12**	U29 RAM CS
TP6	U23 EPROM CS	**TP13**	U9 µPROC PIN 25 (ALE) OUT
TP7	U27 EEPROM CS		


CAL
NORMAL
P2
Position
J1/P2
NORM
SERV
SW1
TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
W1-6
W7-10
W11-14
TP01
SW01
P02
R08
U20
C21
U09
C10
C12
C35
U11
Y01
C33
U32
C01
R01
C03
C34
U02
R04
U1
C02
R11
RN01
J1/P3
U21
C22
W10
R09
C26
C23
C24
C25
U22
U23
U24
U25
C11
U10
C17
U16
C15
U14
C09
U08
C06
U05
C07
U6
R10
U30
C31
C18
U17
C19
U18
C14
U13
C05
U04
C16
U15
C20
U19
L01
C08
U07
C13
U12
R05
R06
R07
R02
C04
U03
C32
R03
C28
C29
C30
C27
U27
U28
U26
U29
RN02
P01
(Front) 1
P1
49
(Back) 2
(To A28XA23)
50


A23
MICROPROCESSOR

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6E-6. A23 Microprocessor PCB Parts Locater Diagram
6700-D-31723-3 (Rev. F)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
E PROM
EE PROM
+5V
R8
10K
J1
CAL
P2
NC
NORMAL
W1
W2
U20B
74LS139
W3
W4
A15
A16
CODE SEL
1/B8
C23
C24
C28
C29
0.1
U22
27256
(27512)
U23
27256
(27512)
U27
28256
(2864)
U28
28256
(2864)
W6
W5
ADDR BUS
ID BUS
U21A
74LS139
A13
A14
DATA SEL
W7
W8
W9
W10
U21B
74LS139
CAL DATA
C22
C25
C26
C27
C30
U24
2764
U25
DS1225
R9
10K
U26
DS1225
U29
6264
NC
RD
WR
RAM
NON-VOLATITLE
RAM
RAM

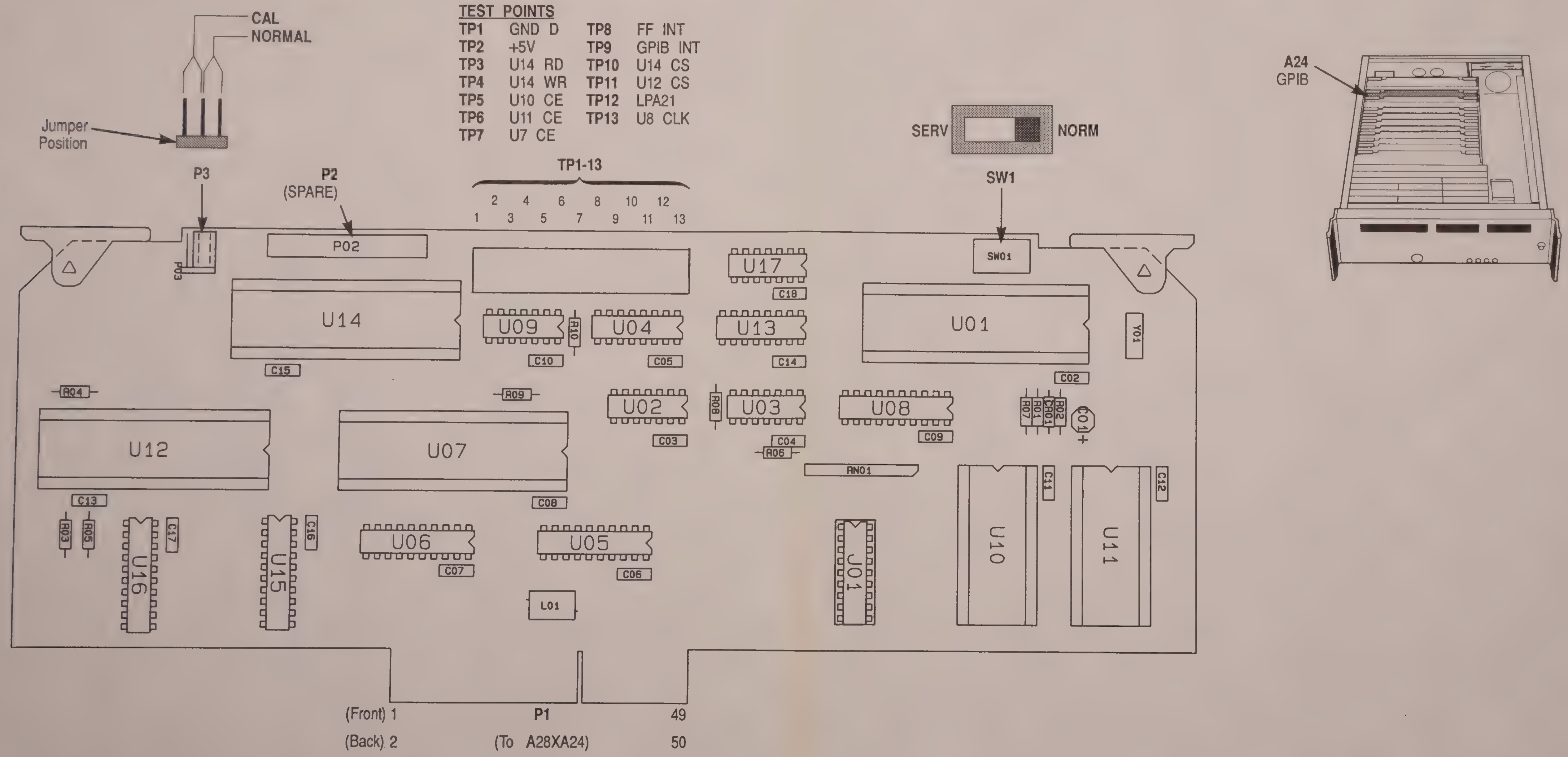
JUMPER TABLE	
IC USED	JUMPERS
27256	W2 W3 W5
27512	W1 W4 W6
28256	W8 W10
2864	W7 W9

A23 MICROPROCESSOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/83
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   ISOLATED GROUNDS: ▽
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   U1-U13, U20, U21, U24-U27, U29, U30, Y1
7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C35	CR1
CR2	P1
J1	U31
L1	W1
P3	W4
R11	W6
RN2	W8
U32	W10
W13	W11
Y1	

Figure 6E-7. A23 Microprocessor PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31723-3 (Rev. F)



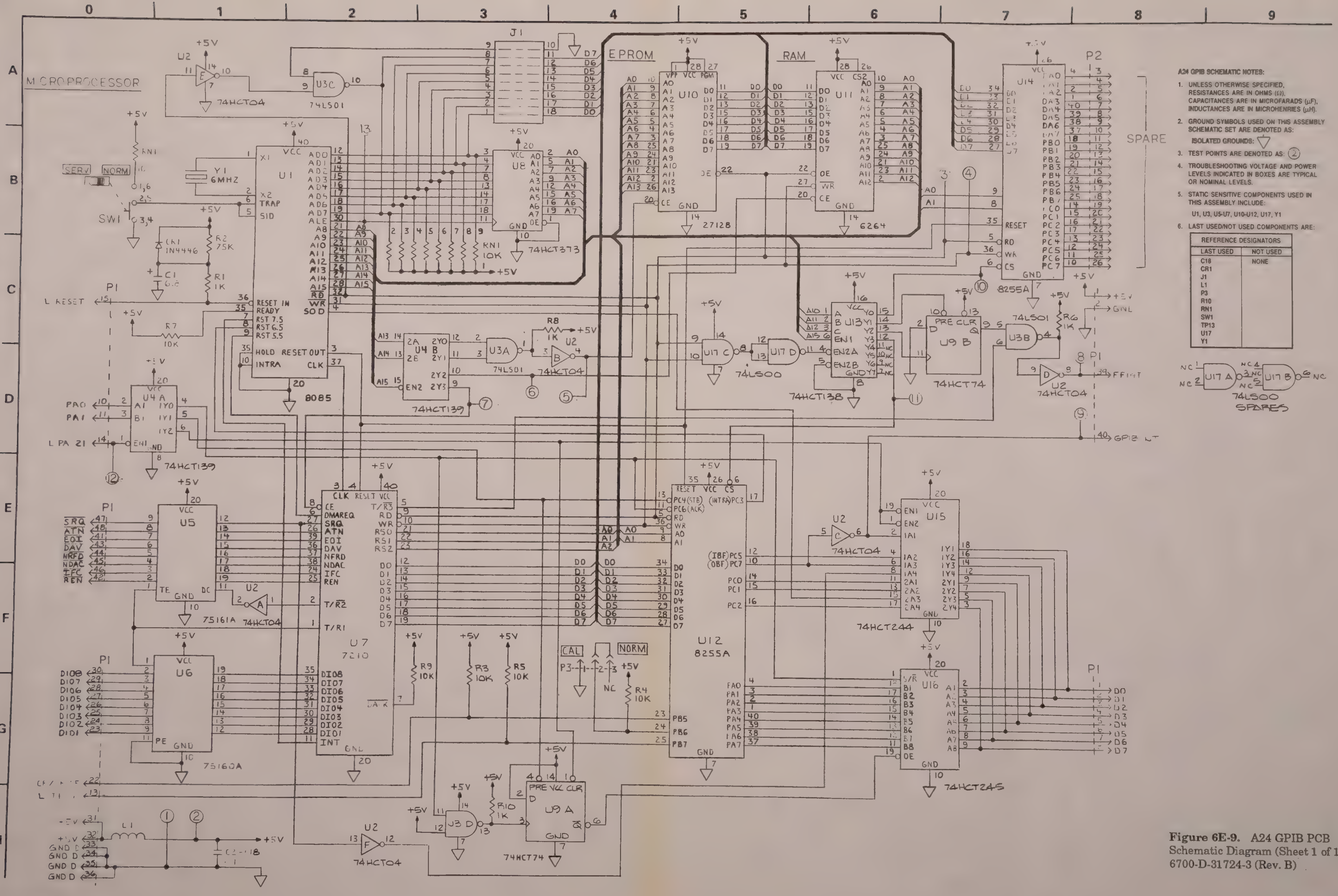
TEST POINTS

TP1	GND D	TP8	FF INT
TP2	+5V	TP9	GPIB INT
TP3	U14 RD	TP10	U14 CS
TP4	U14 WR	TP11	U12 CS
TP5	U10 CE	TP12	LPA21
TP6	U11 CE	TP13	U8 CLK
TP7	U7 CE		

CAL
NORMAL
Jumper Position
P3
P2 (SPARE)
TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
SERV
NORM
SW1
A24 GPIB
P03
P02
SW01
U17
C18
U14
U09
R10
U04
U13
U01
Y01
C15
C10
C05
C14
C02
R04
R09
U02
R08
U03
U08
R07
R01
CR01
R02
Q01
+
U12
U07
C03
C04
R06
C09
RN01
C11
C12
C13
C08
R03
R05
U16
C17
U15
C16
U06
U05
J01
U10
U11
C07
C06
L01
(Front) 1
(Back) 2
P1
(To A28XA24)
49
50

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6E-8. A24 GPIB PCB Parts Locater Diagram 6700-D-31724-3 (Rev. B)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
MICROPROCESSOR
EPROM
RAM
SPARE
SERV
NORM
SW1
Y1 6MHZ
CR1 1N4446
R2 75K
R1 1K
C1 6.8
R7 10K
RN1 10K
R8 1K
R6 1K
R9 10K
R3 10K
R5 10K
R4 10K
R10 1K
L1
U1 8085
U2 74HCT04
U3C 74LS01
U3A 74LS01
U3B 74LS01
U3D
J1
U8 74HCT373
U10 27128
U11 6264
U14 8255A
P2
U4A 74HCT139
U4B 74HCT139
U17C U17D 74LS00
U13 74HCT138
U9B 74HCT74
U9A 74HCT74
U5 75161A
U6 75160A
U7 7210
U12 8255A
U15 74HCT244
U16 74HCT245
P1
P3
CAL
NORM
NC
+5V
RESET IN
READY
RST 7.5
RST 6.5
RST 5.5
HOLD
INTRA
RESET OUT
CLK
X1
X2
TRAP
SID
SOD
ALE
RD
WR
L RESET
PA0
PA1
L PA 21
SRQ
ATN
EOI
DAV
NRFD
NDAC
IFC
REN
DIO8
DIO7
DIO6
DIO5
DIO4
DIO3
DIO2
DIO1
FFINT
GPIB INT
DO
D1
D2
D3
D4
D5
D6
D7
GND D
U17 A
U17 B
74LS00
SPARES

A24 GPIB SCHEMATIC NOTES:

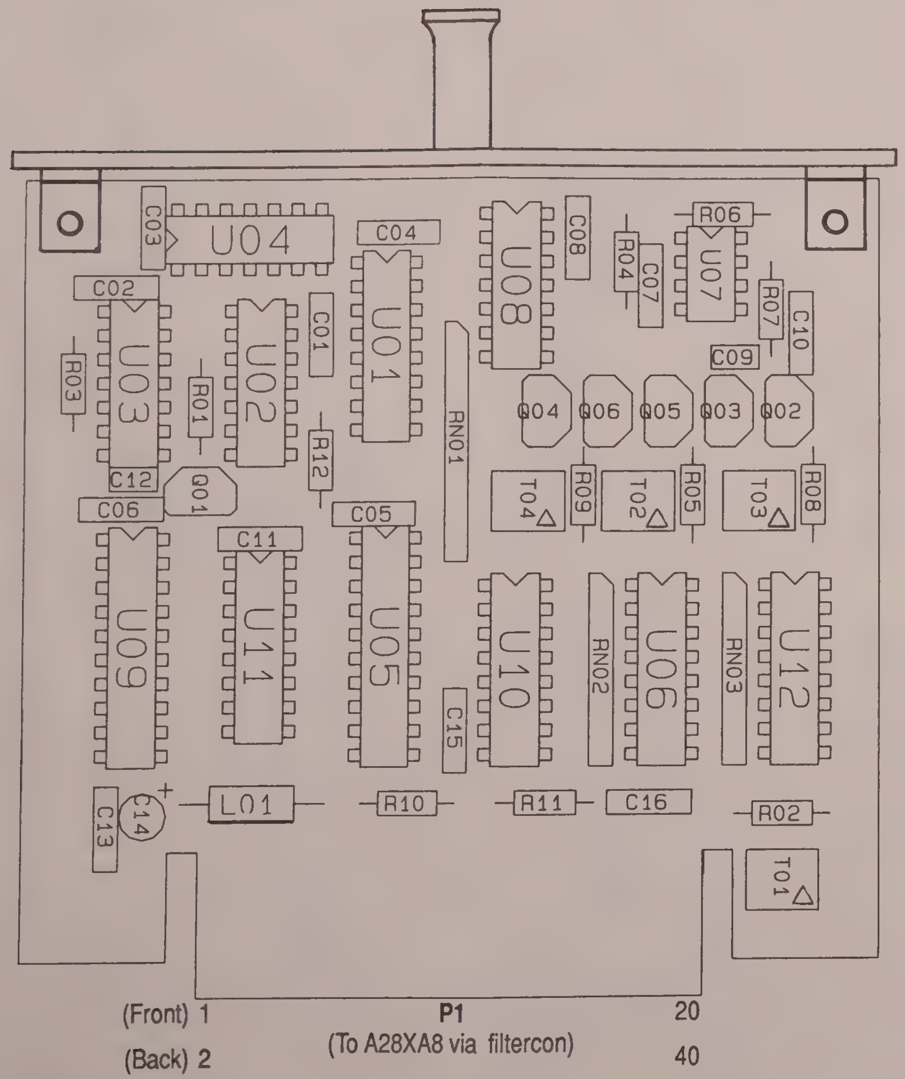
1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   ISOLATED GROUNDS: ▽
3. TEST POINTS ARE DENOTED AS: ②
4. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
5. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   U1, U3, U5-U7, U10-U12, U17, Y1
6. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C18 CR1 J1 L1 P3 R10 RN1 SW1 TP13 U17 Y1	NONE

Figure 6E-9. A24 GPIB PCB Schematic Diagram (Sheet 1 of 1)
6700-D-31724-3 (Rev. B)


C03
U04
C04
U08
C08
R04
C07
R06
U07
R07
C10
C09
C02
R03
U03
R01
U02
C01
U01
RN01
Q04
Q06
Q05
Q03
Q02
C12
Q01
R12
T04
R09
T02
R05
T03
R08
C06
C11
C05
U09
U11
U05
C15
U10
RN02
U06
RN03
U12
C13
C14
+
L01
R10
R11
C16
R02
T01
(Front) 1
(Back) 2
P1
(To A28XA8 via filtercon)
20
40

NOTE:
Leading zeros on component number references may be disregarded.

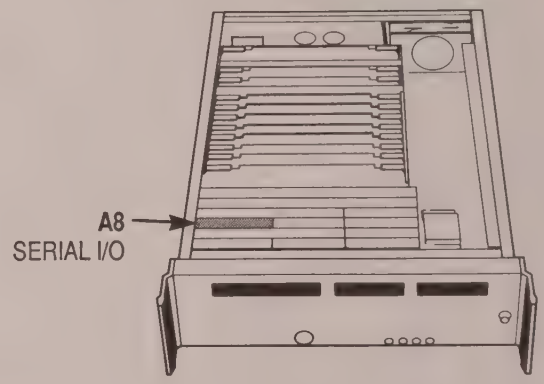
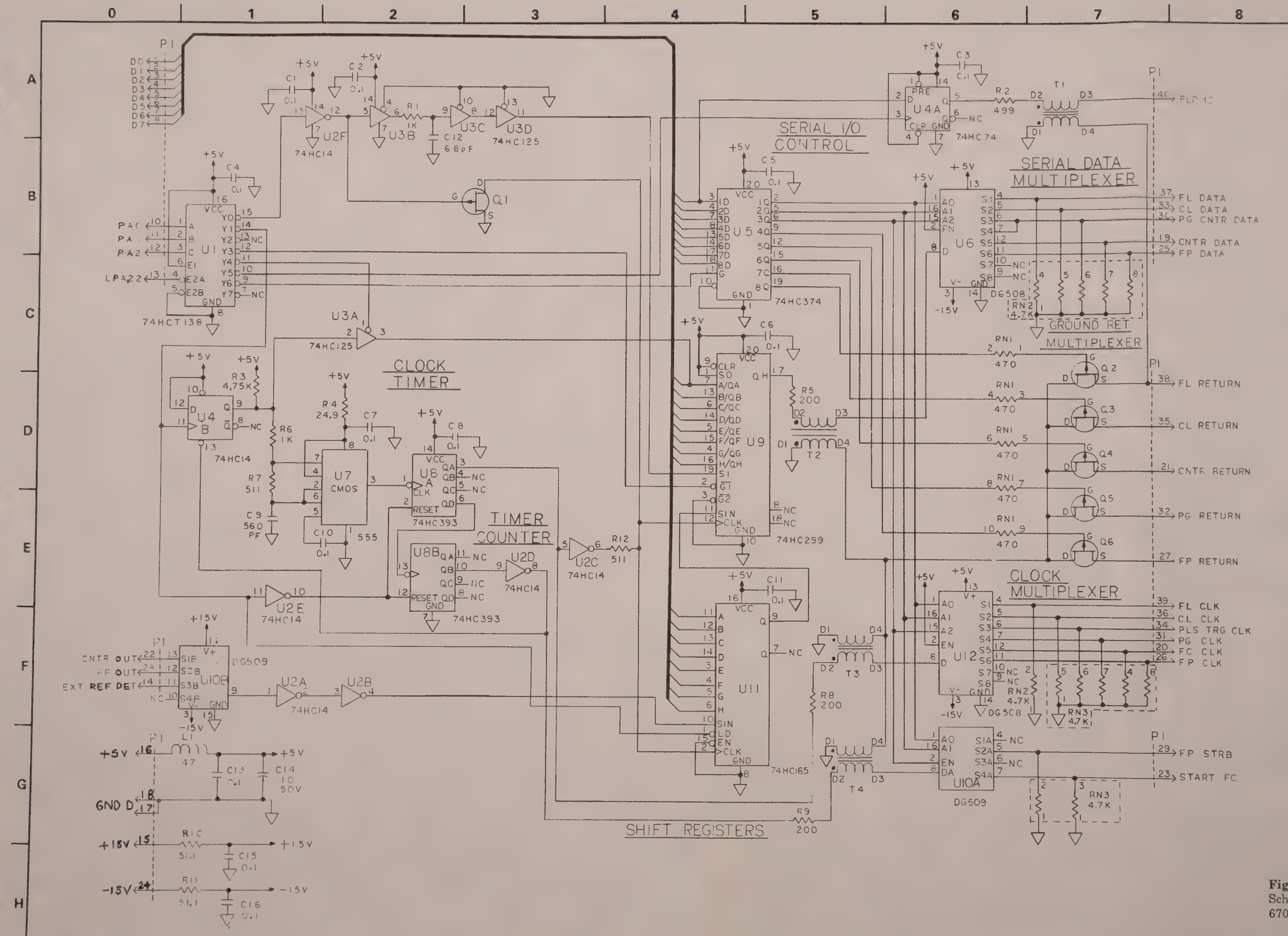

A8
SERIAL I/O

Figure 6E-10. A8 Serial I/O PCB Parts Locater Diagram 6700-D-31708-3 (Rev. C)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
P1
D0
D1
D2
D3
D4
D5
D6
D7
SERIAL I/O CONTROL
SERIAL DATA MULTIPLEXER
GROUND RET MULTIPLEXER
CLOCK TIMER
TIMER COUNTER
CLOCK MULTIPLEXER
SHIFT REGISTERS
74HCT138
74HC14
74HC125
74HC374
74HC74
DG508
74HC299
74HC393
555
CMOS
74HC165
DG509
U1
U2A
U2B
U2C
U2D
U2E
U2F
U3A
U3B
U3C
U3D
U4A
U4B
U5
U6
U7
U8A
U8B
U9
U10A
U10B
U11
U12
Q1
Q2
Q3
Q4
Q5
Q6
T1
T2
T3
T4
PA0
PA1
PA2
LPA22
CNTR OUT
FP OUT
EXT REF DET
+5V
GND D
+15V
-15V
FLD IO
FL DATA
CL DATA
PG CNTR DATA
CNTR DATA
FP DATA
FL RETURN
CL RETURN
CNTR RETURN
PG RETURN
FP RETURN
FL CLK
CL CLK
PLS TRG CLK
PG CLK
FC CLK
FP CLK
FP STRB
START FC

A8 SERIAL I/O SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   ISOLATED GROUND: ▽
4. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   Q1-Q6, U6, U7, U10, U12
5. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C16 L1 Q6 R12 RN3 T4 U12	NONE

Figure 6E-11. A8 Serial I/O PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31708-3 (Rev. C)

6F– INPUTS/OUTPUTS A27 AND P/O A29 PCBs

6F-1 INPUTS/OUTPUTS ASSEMBLIES: A27 AND A29 PCBs

This section contains service information for the PCB assemblies listed in Table 6F-1 below. Refer also to the general reference information in sections 6A, 6B, and 6C.

Table 6F-1. Inputs/Outputs Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6F-2	6F-1
Block Diagram	Fig. 6F-1	6F-1
Troubleshooting	Tbl. 6F-1	6F-6
PCB LEVEL		
A27 Auxiliary I/O PCB		
General Circuit Description	Para. 6F-3	6F-2
Detailed Circuit Description	Para. 6F-5	6F-3
Troubleshooting	Tbl. 6F-2	6F-7
Parts Locator Diagram	Fig. 6F-3	6F-12
Schematic (Sheet 1 of 1)	Fig. 6F-4	6F-13
A29 Rear Panel Interface		
General Circuit Description	Para. 6F-4	6F-2
Detailed Circuit Description	Para. 6F-6	6F-3
Block Diagram	Fig. 6F-2	6F-11
Troubleshooting	Tbl. 6F-2	6F-7
Parts Locator Diagram	Fig. 6F-5	6F-14
Schematic (Sheet 1 of 5)	Fig. 6F-6	6F-15
Schematic (Sheet 2 of 5)	"	6F-17
Schematic (Sheet 3 of 5)	"	6F-19
Schematic (Sheet 4 of 5)	"	6F-21
Schematic (Sheet 5 of 5)	"	6F-23

6F-2 INPUTS/OUTPUTS ASSEMBLIES, OVERALL DESCRIPTION

This section covers the PCB assemblies that handle the rear panel BNC connector signal inputs. Generally, these are signals that interface the 67XXA with other instruments, such as a network analyzer. As shown in the block diagram in Figure 6F-1, these circuits reside completely on the A29 Rear Panel Interface PCB and on the A27 Auxiliary I/O PCB. All interface signals are entirely under microprocessor contol.

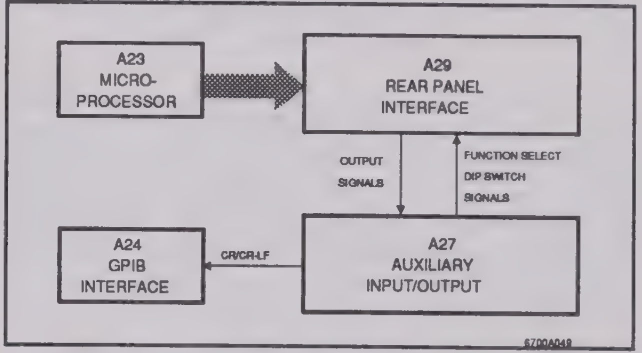


Figure 6F-1. Inputs/Outputs Block Diagram

The A27 Aux I/O PCB's primary purpose is to route all interface signals to the appropriate 67XXA rear panel connector. Additionally, two relays on the A27 PCB control penlift drive and determine retrace and blanking signal polarity. (The A27 PCB has no interaction with, or control of, signal inputs from the *front panel.*)

The A29 Rear Panel Interface has several primary functions:

- Using a 0-10V analog ramp and a +10V reference from the A17 Analog Instruction PCB, and digital information from the A23 Microprocessor PCB, the A29 PCB DAC circuits construct HORIZ OUTPUT, V/GHz, and ALC SLOPE signals.
- Instrument interface signals such as retrace and band switch blanking, penlift control, lock output, sequential sync, and markers are latched on the A29 PCB.
- Microwave deck control circuits reside on the A29 PCB for: attenuator control, sampler switch drive, RF output band switch drive, switched filter drive, down converter selection, and modulator drive.

6F-3 A27 AUXILIARY I/O PCB, GENERAL DESCRIPTION

Refer to the schematic in Figure 6F-4 for the following circuit discussion.

The A27 Aux I/O PCB interfaces the signals from the A29 Rear Panel Interface PCB to the rear panel connectors. J1 is a 25-pin D-type connector that connects to the WILTRON 560A or 561 Scalar Network Analyzer. Many of its signals parallel the signals on the rear panel BNC connectors. J2 is a 14-pin DIL connector that interfaces to a ribbon cable. The wires of this ribbon cable are then connected to the BNC connectors on the rear panel.

The S1 DIP switch provides for selecting default operational parameters. The A23 Microprocessor PCB (main microprocessor) reads the switch positions of all but one of the S1 switches from a latch on the A29 Rear Panel Interface PCB. The switch position of the remaining switch, CR/CR-LF, is read by the microprocessor on the A24 GPIB PCB.

Relay K1 routes either the positive or the negative blanking signals to the connectors depending on the position of the BLANK +/– SEL switch on S1.

Relay K2 is the penlift relay. It can be either normally closed or normally open during sweep. Its condition is set by the PEN LIFT +/– SEL switch on S1.

6F-4 A29 REAR PANEL INTERFACE PCB, GENERAL DESCRIPTION

Refer to the A29 block diagram in Figure 6F-2 for the following description.

The U3 Switch Position Latch senses the settings of the S1 DIP Switch located on the A27 Aux I/O board. This latch is read every 50 ms by the A23 Microprocessor during housekeeping routines. The U1 Mem Seq Latch interfaces sweep dwell, memory sequence, and the RF unleveled LED signal to the A23 Microprocessor PCB. The status of these signals is monitored during housekeeping and is summed with the operational routines in the microprocessor. The U8 DAC LSB Latch and U9 DAC MSB Latch respectively buffer the 4-Bit DAC LSB Bus and the 8-Bit DAC MSB Bus to the DACs that determine the V/GHz and horizontal outputs.

During analog sweep, the ramp coming from the A17 Analog Instruction PCB goes to U11 through the U12 analog switch. From U11, the signal goes to the A27 PCB (via the A28 Motherboard PCB) then to the rear panel HORIZ OUTPUT connector. During CW or stepped sweep operation, a dc voltage from the stepped sweep DAC goes through the U12 analog switch to U11.

The U13 V/GHz Width DAC and the U15 Offset DAC circuits provide the 0.5V/GHz and 1V/GHz necessary for interfacing to some network analyzers. During analog sweep, the ramp from the A17 Analog Instruction PCB goes to the U13 V/GHz Width DAC. This DAC attenuates the ramp according to the sweep width and applies the attenuated ramp to summing amplifier U14. Here, the ramp sums with the dc voltage from the U15 V/GHz Offset DAC. The voltage from U15 is set according to the center frequency of the sweep. U14 then amplifies the sum of these two voltages and applies them to the A27 PCB, via the A28 Motherboard PCB. In CW or stepped sweep, U13 is set for zero output; thus, only the voltage from U15 goes to the U14 amplifier.

The outputs from the U13 and U15 DACs also go to U16. An offset voltage (2 GHz SLOPE OFFSET) also goes to U16, via U12 analog switch. This voltage sets U16 so that a 0V output corresponds to 2V (1V/GHz) or 1V (0.5V/GHz) of the V/GHz output. This allows independent control of the slope for Band 0 and Bands 1–4. The output of U16 goes to the A15 ALC PCB where it is summed with the ALC reference voltage. This corrects for any any slope in the output power due to the optional step attenuator.

The U4 Blank and Seq Sync Latch provides the blanking, sequential sync, markers, and penlift controls to the A27 Aux I/O PCB. There, they are interfaced to the rear panel BNC connectors.

The ALC circuits are also resident on the A29 PCB; they are discussed in the A29 Detailed Circuit Description and in section 6M, ALC/Pulse Modulation.

6F-5 A27 AUXILIARY I/O PCB DETAILED CIRCUIT DESCRIPTION

The A27 PCB, shown in the Figure 6F-4 schematic, is an interface from the A28 Motherboard to the rear panel BNC connectors and the D-type AUX I/O connector. J1, the PCB-mounted AUX I/O connector, is intended to interface with either a Wiltron 560, 560A, or 561 Network Analyzer. There is also a DIP switch for setting the default parameters for several functions.

Q2 is controlled by a TTL signal from the A29 Rear Panel Interface PCB and drives K2 pen lift relay. Q1 is also controlled by the A29 PCB and drives K1 relay. K1 connects the RETRACE BLANK OUTPUT and BAND SWITCH BLANK on the rear panel to either the positive or negative signals from A29. The BLANKING +/– switch portion of S1 DIP switch determines the position of K1.

In the open position, the S1 switches cause a TTL high signal to be on its input pins. Closing any one of these switches grounds that signal. This TTL high or low is monitored by a data latch on the A29 Rear Panel Interface PCB. The A23 Microprocessor then sets the related function according to the position of this switch.

The switch functions are:

- **PEN LIFT +/–** causes the pen lift relay to be either open or closed during sweep.
- **BLANK +/–** selects either positive or negative retrace and bandswitch blanking via K1 relay.
- **PULSE +/–** selects whether a positive TTL level applied to the front or rear panel pulse inputs will turn RF power *on* or *off*.
- **V/GHZ** sets either 1V/GHz or 0.5V/GHz for the rear panel BNC connector output level.
- **AC/DC AM** selects either ac or dc coupling for the front and rear panel AM inputs.
- **RETRACE RF ON/OFF** selects either RF *on* during retrace or RF *off* during retrace (in analog and step sweep).
- **Δ FREQ RF ON/OFF** select either RF on or RF off when switching between frequencies in step sweep.
- **CR–CR/LF** selects either the CR and CR/LF characters for GPIB terminators. This signal comes from the A24 GPIB PCB.

6F-6 A29 REAR PANEL INTERFACE PCB DETAILED CIRCUIT DESCRIPTION

Refer to the five-sheet schematic set in Figure 6F-6 for the following discussions.

NOTE

> Descriptions of the A29 PCB's ALC circutry is presented here to maintain continuity of the A29 service information and to reduce the bulk of foldouts in section 6M. Please note that the Inputs/Outputs circuitry and ALC circuitry is electrically separate; each uses separate power supply and ground references.

6F-6.1 Microprocessor Interface

As shown on schematic sheet 1, U1 latch monitors the state of **L MEM SEQ IN**, **L SWEEP DWELL IN**, and **L RF UNLVLD**. The A23 Microprocessor reads the state of these lines during housekeeping approximately every 50 ms. U2B and U2C are arranged as a flip-flop. When an unleveled condition occurs, U2C-8 goes high. When the microprocessor reads U1 and determines that an unleveled condition has occured, it sends the proper signals to U6 which resets U2B and U2C. (This procedure is used for the ALC's automatic EXT GAIN CAL, initiated from the 67XXA front panel.)

When the rear panel MEMORY SEQ INPUT is brought low, **L MEM SEQ IN** is sensed by U1. The A23 Microprocessor reads U1 and determines when this line has been brought low. It then begins the procedures to sequence the current front panel setup to the next setup that is stored in memory.

L SWEEP DWELL IN also comes from the rear panel to the A29 PCB (it also goes to the A17 Analog Instruction PCB). When the 67XXA is sweeping and this line is brought low, the sweep dwells (stops and waits). This dwell is also monitored by the A23 Microprocessor via latch U1.

Latch U3 monitors the state of the rear panel DIP switches. The A23 Microprocessor reads U3 during housekeeping and changes effected functions associated with the rear panel switch labels.

U6 and U7 are address decoders that are controlled directly by the A23 Microprocessor. The outputs are typically 800 ns wide pulses that load data latches or DACs. U6-9 strobe resets the U2B-U2C flip-flop.

U4 data latch provides the rear panel signals for blanking, marker, sequential sync, lock output, and penlift relay drive. U5A inverts the TTL output of U4 to provide for negative retrance blanking. U5B inverts the bandswitch blanking. The blanking polarity signal drives the blanking polarity relay on the A27 Aux I/O PCB to select either plus or minus retrace and band switch blanking. The state of this signal is determined by the A23 Microprocessor from either the switch position on the rear panel via U3 or the GPIB.

U5C supplies the sequential sync output to the rear panel. It is comprised of a plus TTL input from U4-19 during retrace and band switch blanking. The plus marker TTL signal from U4-15 is inverted by U5C. This causes the sequential sync to go to –5V for a marker. When a marker is selected from the front panel, such as F5, the signal at U5-16 also goes positive at the same time as the signal at U4-15. This signal is also inverted by U5C. It adds this to the marker from U4-19 which provides a –10 v enhanced marker output for the F5 marker. The other markers remain at –5V at the sequential sync output.

Shown on sheet 2 of the A29 PCB schematic set, U8 and U9 data latches provide for a buffered 12-bit data bus for the 12-bit DACs and an 8-bit data bus for other latches used on the A29 PCB. In addition, U8 provides **L ALT EN** and **L ALT 1** signals to the rear panel AUX I/O connector. These signals are required for operation with the 560A or 561 network analyzers in their alternate sweep mode of operation.

6F-6.2 12 Bit DACs

The data for digital-to-analog converters U10, U13, and U15 are first latched onto the internal data bus by U8 and U9 data latches. The data is then strobed into the internal latches in the DAC.

U10 and U11A provide the horizontal output to the rear panel in CW or step sweep mode of operation. In analog sweep, an analog ramp from the A17 Analog Instruction PCB goes to the rear panel. These two horizontal output signals are selected by U12A and U12D analog switches. They are then buffered by U11B.

U12 and U11D provide the V/GHz ramp signal in analog sweep and the slope control signal for the A15 ALC PCB. U16 and U16A provide the offset for the ramp signal from U11D in analog sweep and the dc V/GHz during CW or stepped sweep. This also combines with the ramp signal in U16B to provide the ALC slope signal for the A15 ALC PCB. U12C and U12B provide an offset to the slope signal for the A15 ALC PCB; it will be 0V at 2 GHz. U12B supplies the offset for 1V/GHz and U12C supplies the offset for 0.5V/GHz. The position of these switches is controlled by U8 via the A23 Microprocessor. There is a physical switch on the rear panel that is monitored via U3 by the microprocessor which then sets the position of these switches.

U14 amplifies the signals from the V/GHz slope and offset DACs for the normal 1V/GHz or 0.5V/GHz at the rear panel. U16B buffers these same signals for application to A15 ALC PCB.

Voltage regulator VR1 supplies –5V to U14 and to the PIN switch drivers.

6F-6.3 Step Attenuator and Relay Drivers

On sheet 3 of the A29 schematic set is U18, a data latch for controlling the state of the microwave deck step attenuator and relay drivers. U17 inverts one of the signals to each of the dual drivers. The U19-U23 drivers require one input to go low as the other goes high. They have open collector outputs to drive the relay coils and are protected by the diodes on each output.

The output of U19 drives transistor switches for an optional relay. It switches +22V to either side of a relay coil via Q1 and Q2.

U20-U23 drive the step attenuator coils. The common line to the step attenuator coils, **ATTEN SUPPLY**, is +22V via P2-23, 24. To switch a step attenuator section in, U20-3 goes open and U20-5 connects the other coil to ground. The inverse is true for removing a step attenuator section.

6F-6.4 PIN Switch Drivers

Shown on sheet 4 of the A29 PCB schematic set is U24, a data latch that controls the selection of the PIN switch drivers. These drivers supply the current for the 4-pole sampler multiplexing switch, the 4-pole main RF output multiplexing switch, and the switched filter, all of which are mounted on the microwave deck.

Each of the drivers is identical except for the resistors determining the current to the PIN switch, therefore, only one driver is discussed.

When U25A-1 is high, the switch driver is in the off mode. Under this condition, the contacts of U25A are open. U29A is saturated by the current through RN3 and supply approximately 4.3V across R49. The current through R49 determines the current to the 20-26.5 GHz port on the main output multiplexing switch and turns it off. The base of Q3 is then at the same potential as the emitter, turning it off.

When U25A-1 goes low, the contacts of U25A close. Q3 is turned on by the current through RN3 and supply current through R53 to the PIN switch, turning it on. The value of R53 determines the current through the PIN diodes in the switch. U29A no longer receives enough base drive, an it turns off.

6F-6.5 PIN Mode Shaper

Refer to sheet 5 of the A29 PCB schematic set. The ALC control signal from the A15 PCB goes to U36, a unity gain differential receiver. From U36, the signal goes to U37 which is configured as a log amplifier. U37 logs the voltage which results in the log of the level amplifier. The U40B transistor in the feedback path of U37 is configured as a diode and has a very high resistance at low input signal levels. As the input signal to U37 goes higher, the output supplies more current to the diode and its resistance decreases causing the gain of U37 to decrease. This change in the resistance of the diode is a logarithmic function so the output of U37 is the log of the input.

The output of U37 goes to U38 which has a gain of a little less than 1. In the 26.5-40 GHz band, U48C parallels R90 with R89. This helps compensate for the characteristics of the doubler/amplifier used in this band. The output of U38 goes to U40C, another transistor configured as a diode. In order for the current in U40C to keep from becoming too small at low signal levels, it must be biased by a small amount of current. This bias is provided by the voltage drop of U40D transistor, which is configured as a diode. The current for this voltage across U40D is provided by R94 from the precision +10V reference supply. CR44 connects the output of U39 back to the input of U38 during overdrive conditions to prevent the output of U38 from going up against the supply rails.

U40D has the same effect at low input signal levels as U40B, that is, its resistance increases. However, since U40D is now in the input of U39, its increase in resistance with lower input voltages results in a decrease in the gain of U39. This performs an antilog function of the voltage from U38, resulting in a nonlinear output voltage versus the ALC control input voltage at U36.

By feeding some of the input signal around U37 and U38 and summing it into U39, the nonlinear output of U39 approximately cancels the nonlinearity of the PIN diodes in the control modulators. This results in a linear change in RF voltage from the control modulator versus the linear input voltage from the ALC level amplifier on the A15 ALC PCB

U48D analog switch parallels R99 with R98 in the 26.5-40 GHz band to further compensate for the characteristics of the doubler/amplifier used in this band. It has the characteristic that each 1 dB change of input power produces a 2 dB change of the output power.

In the 6769A, the two spare sections of U48 are used to provide an adjustment for R99. This improves the loop bandwidth that changes from one band to the other due to the different characteristics of the control modulators.

From U39, the signal goes to U41 quad analog switch. These switches multiplex the signal to the 4 PIN current drivers. These switches are selected by data latch U47.

6F-6.6 PIN Current Drivers

There are 4 PIN current drivers, all identical. These drivers provide the current control for up to 4 control modulators (located on the microwave deck). Since the PIN current drivers are all identical, only one is discussed.

U42 and U46B are configured as constant current sources. Since U46B is an emitter follower, the output of U42 appears at the emitter of U46B, offset by approximately 0.6V. The feedback is provided by R125. Since R129 is a known resistance, a known voltage on the emitter of U46B provides a known current through R129. However, the control modulator diodes with their bias networks typically have approximately 1V across them in the forward biased condition. This voltage also changes with temperature and with individual diodes characteristics. To prevent these voltage changes from affecting the current, R118 feeds this voltage back to the non-inverting input of U42. This provides a constant current that is independent of the voltage at A29J1-2.

CR45 provides protection of U46B when a transient would cause U42 output to go negative. This would break the feedback loop and cause U42 to go against the supply rail. This would be beyond the reverse bias capabilities of U46B.

6F-7 INPUTS/OUTPUTS ASSEMBLIES, TROUBLESHOOTING

Troubleshooting procedures in Table 6F-2 cover the A27 Aux I/O PCB and the A29 Rear Panel Interface circuits covered in this section (additional ALC circuit troubleshooting can be found in section 6M).

6F-8 INPUTS/OUTPUTS ASSEMBLIES, SERVICE SHEETS

Table 6F-1 on the first page of this section presents the arrangements of the block diagrams, schematics, and parts locater diagrams for the A27 and A29 PCBs.

Table 6F-2. Inputs/Outputs Troubleshooting (1 of 4)

Trouble / Error Code	Troubleshooting Procedure
	Problems in the Inputs/Outputs Assemblies can be localized to the A27 Aux I/O, A29 Rear Panel Interface, or their associated interconnections. Most of the input/output signals are either derived via the A23 Microprocessor or cause the A23 Microprocessor to take a particular action. The following procedures are grouped into three categories: • General Front/Rear Panel BNC Connector Troubleshooting • A27 Aux I/O PCB Troubleshooting • A29 Rear Panel Interface PCB Troubleshooting
	General Front/Rear Panel BNC Connector Troubleshooting
MEMORY SEQ INPUT	Check that the contact closure at the input is being received by the A29 PCB (A29P3-9). If it is being received, A29U1 or A29U6 circuits are the cause of the problem. If it is not being received by the A29 board, there is an open circuit between the BNC connector and the A29 PCB via the A27 or A28 PCBs.
SWEEP DWELL INPUT	Check that a ground applied to the input reaches A28XA17-54. If it does not, there is an open circuit between the BNC connector and XA17 via the A27 and A28 PCBs. If the signal is reaching the A17 PCB, the cause of the problem is either the A17U23 or A17U4 circuits.
HIGH RES INPUT	Press <Shift> TRIGGER 011. Note the frequency of the Fine Loop Oscillator on the FREQUENCY display. Set an external signal source to 1/10th of this frequency at 0 dBm output power and connect it to the HIGH RES INPUT on the rear panel. Press <Shift> RESET to return to normal front panel operation and then press <Shift> TRIGGER 002. Observe the RF output of the synthesizer with a frequency counter or spectrum analyzer. Increase or decrease the external signal source frequency by 1 MHz. The synthesizer output should also increase or decrease by 1 MHz. • If the synthesizer frequency does not change as described above, check that the signal is being received at A12J2. If the signal from the external source is not at A12J2, replace the cable from the rear panel to A12J2. If the signal is there, check A28XA12-3. This signal should be a TTL low. If it is not a TTL low, the A16U9 data latch is most likely defective. If this signal is correct and the external source signal is reaching A12J2, go to the YIG Loop troubleshooting in section 10J.
10 MHz REF INPUT	Apply a 10 MHz ±100 Hz, 0 dBm signal to the rear panel 10 MHz REF INPUT. The front panel FREQUENCY display should show the EXT REF message on the right side of the display and the unit should be phase locked in the CW mode of operation. If the EXT REF message is not displayed, check A28XA7-3. This should be a TTL high. If it is not, go to the Reference Loop troubleshooting in section 6G. If this signal is a TTL high, either A8U10 and its associated circuits or A2U15 and its associated circuits are defective.
10 MHz REF OUTPUT	If there is no 10 MHz REF OUTPUT, go to the A7 Reference Divider PCB troubleshooting in section 10G.

Table 6F-2. Inputs/Outputs Troubleshooting (2 of 4)

Trouble / Error Code	Troubleshooting Procedure
	General Front/Rear Panel BNC Connector Troubleshooting (Continued)
SWEEP TRIGGER INPUT	Set the synthesizer for an F1-F2 analog sweep. Ensure that the TRIGGER is in the EXT mode. Press <Shift> INT 1 KHz RATE and connect the rear panel PULSE SYNC OUTPUT to the rear panel SWEEP TRIGGER INPUT. If the sweep is not triggering, it indicates either the signal is not reaching A28XA23-42 or A23U3, A23U4 circuits are defective. • If the 1 kHz signal is not reaching A28XA23-42, it points to an open circuit from the rear panel connector via A27 to the A23 PCB.
One or more of the following rear panel outputs is (are) incorrect: BAND SWITCH BLANK, RETRACE BLANK OUTPUT, LOCK OUTPUT, SEQ SYNC OUTPUT, PEN LIFT, MARKER OUTPUT	These signals are generated by the A29U4 data latch and A29U5 buffer amplifier. Either one of these circuits can cause an improper output of one or more of the outputs. If you can get one or the other plus/minus polarity RETRACE BLANK and BANDSWITCH BLANK signals, but you cannot get both polarities, it indicates the A29U4 data latch or A27Q1-K1 is defective. An inoperative PENLIFT indicates either A29U4 data latch or A27Q2-K2 circuits are bad. The absence of a LOCK OUTPUT signal indicates a defective A29U4 data latch or interconnect between the A29 PCB and the BNC output connector.
No output from LOCK OUTPUTwhen 6747A-20 is actually phase locked	This signal is generated by the A29U4 data latch and A29U5 buffer amplifier. Either one of these circuits can cause an improper output of one or more of the outputs. The absence of a LOCK OUTPUT signal indicates a defective A29U4 data latch or interconnect between the A29 PCB and the BNC output connector.
V/GHz OUTPUT	This indicates A29U11, U13, U14, U15, or U16 circuits are defective. • Check A29P1-1 for the +10V reference. If this voltage is not present, go to the A17 Analog Instruction troubleshooting in section 6K. • Check A29U11-8 for −10V. If this voltage is not present, A29U11 circuit is defective. With the FUNCTION SELECT switch set to 1V/GHz and the synthesizer set for a CW frequency of ≤20 GHz, the voltage at A29U16-1 should be approximately 1/2 (10K/20.5K) of the frequency indicated on the front panel FREQUENCY display. If this voltage is incorrect, either A29U16 or A29U15 circuits are defective. If this voltage is correct and the voltage at A29U11-14 is 0V, but the voltage at A29U14-6 is incorrect, it indicates that the A29U14-6 circuit is defective. The proper voltage at A29U14-6 is 2.05 times the voltage at A29U16-1. • If the voltage at A29U11-14 is not 0V under the above conditions, A29U11 or A29U13 circuit is defective. Press ΔF F5 and ENTER ΔF keys. Enter 1 GHz on the keypad. Use the scan keys to select F5 and enter a frequency below 19 GHz. The peak-to-peak voltage at A29U11-14 should be 0.488 V. If the voltage is incorrect, either the A29U11 or A29U13 circuits are defective. If this voltage is proper but the peak-to-peak voltage at A29U14-6 is not 1V, the A29U14 circuit is defective.

Table 6F-2. Inputs/Outputs Troubleshooting (3 of 4)

Trouble / Error Code	Troubleshooting Procedure
	General Front/Rear Panel BNC Connector Troubleshooting (Continued)
No HORIZ OUTPUT in analog sweep	Check that the A17 analog instruction board is sweeping by looking at A29P1-2 with an oscilloscope. There should be a 0 to 10V ramp at this point. If not, go to the A17 Analog Instruction PCB troubleshooting in section 10K. If the ramp is present at A29P1-2, but not at U11-7, U12D or U2A is defective.
No PULSE SYNC OUTPUT	Refer to the A13 Pulse Generator PCB troubleshooting in section 10M.
Front panel EXT FM or rear panel FM INPUT inoperative	Go to the FM troubleshooting in section 10J.
Front panel EXT AM or rear panel AM INPUT inoperative	Go to the ALC troubleshooting in section 10M.
Front panel EXT LEVEL or rear panel PULSE INPUT inoperative	Go to the ALC troubleshooting in section 10M.
	A27 Aux I/O PCB Troubleshooting
One or more of the rear panel FUNCTION SELECT switch settings inoperative	Check A27S1 for closure of the switch contacts. The output of these switch settings should be 0V or a TTL high, depending on the position of the switch. Also check that the signals are going through the A28 Motherboard PCB to the A29 Rear Panel Interface PCB; refer to the A28 Motherboard schematic signal lines in section 6P. If the signals are arriving at the A29 PCB, the A29U3 data latch or A29U6 address decoder are the most likely suspects. **NOTE** The CR-CR/LF positions of A27S1 are monitored by the A24 GPIB board.
	A29 Rear Panel Interface PCB Troubleshooting
CW Horiz DAC	Check this DAC in the CW or step sweep mode. It should have a 0V output at the low end frequency of the unit (or the low end frequency of the step sweep), and +10V at the high end of the unit frequency range in CW (or the high end of the sweep in step sweep). If the output does not change, check that the strobe is getting to U10-2. If there is an eratic output, first check U16A-1. Its voltage output should be about 1/3 of the output frequency indication in CW and go in a linear step from 1/3 of the sweep start frequency indication to 1/3 of the stop frequency indication with no eratic jumps. If this DAC has the same characteristic as the CW Horiz DAC, it indicates either U8 and U9 data latches are defective. If the U15 DAC check okay but the U10 DAC is erratic, it indicates U10 DAC is defective. If there is an output at U11-1 but no output at U11-7, it indicates U12 analog switch or U2 inverter is defective. (Make sure you are in CW or step sweep for this check.)

Table 6F-2. Inputs/Outputs Troubleshooting (4 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A29 Rear Panel Interface PCB Troubleshooting (Continued)
Microprocessor Interface Problems	Check U1 and U3 data latches; monitor the inputs with an oscilloscope while switching the rear panel switches or apply a ground to the appropriate rear panel BNC inputs. If the level changes on the input pins, the interconnection circuitry is in order. Check that the corresponding function occurs by monitoring that function and changing the switch position or signal input to the rear panel BNC connectors. As an example, observe the swept RF output with an oscilloscope and a crystal detector. Then change the RETRACE RF ON/OFF switch on the rear panel. This should cause the RF during retrace to go on and off. Penlift relay contacts can be checked with an ohmmeter. In one position of the PENLIFT +/– switch, the contacts should close during sweep and open during retrace. In the other position, the contacts should open during sweep and close during retrace. U4 data latch may be checked from the rear panel by monitoring the blanking, marker, sequential sweep, bandswitch blanking, etc. If the signal outputs are not on the rear panel BNC connectors, trace them back to U4 data latch. If they are not coming out of the data latch, U4 is most likely defective.
V/GHZ Slope DAC	Set the synthesizer for a full band sweep by pressing <Shift> RESET, F1-F2 SWEEP, ANALOG SWEEP. Look at U11-14 with an oscilloscope and adjust the F2 frequency from its maximum to minimum. The output voltage of U11D should go from approximately 1/3 of the F2 frequency indication (with the rear panel switch set to 1V/GHZ) to 0V when the F2 frequency indication is the same as the F1 frequency indication. When the rear panel switch is in the 0.5V/GHz position, it should go from approximately 1/6 of the F2 frequency to 0V when F2 is the same as F1. If there are erratic jumps, check the CW Horiz DAC. If it is also erratic, U8 or U9 data latches are most likely defective. If they are in order, U13 DAC is most likely defective.
V/GHZ Offset DAC	Set the synthesizer for a full band sweep by pressing <Shift> RESET, F1-F2 SWEEP, STEP SWEEP. Check U16-1 with an oscilloscope. The voltage should go from approximately 1/3 of the F1 frequency indication (with the rear panel switch set to 1V/GHz) to approximately 1/3 of the F2 frequency indication when the F1 frequency is the same as the F2 frequency. If the output is not a smooth change or is erratic, check the CW Horiz DAC. If it is also erratic, U8 or U9 data latches are most likely defective. If not, then U15 DAC is most likely defective. Check U14 by checking the V/GHz output with the CW frequency output. If it is not proper but the DACs check okay, then U14 is most likely defective. The output of U16B is used for the ALC slope control on the A15 ALC PCB. Its output should be the sum of the V/GHZ Slope DAC and the V/GHZ Offset DAC. The frequency at which its output passes through 0V is 2 GHz (with the rear panel switch set to 1V/GHz or 0.5V/GHz. If U16B output does not pass through 0V at 2 GHz, check U12B and U12C analog switches and the +10V reference from A29P1-1 (which comes from the A17 Analog Instruction PCB).
	Miscellaneous Inputs/Outputs Troubleshooting
Network analyzer will not operate in Alternate Sweep Mode with 67XXA	Press <Shift> RESET. Press F1-F2 and <Shift> F3-F4 ALT. Set the synthesizer for analog sweep. Monitor pin 4 of rear panel AUX I/O connector J1 (on the A27 Aux I/O PCB). It should be 0V. Monitor pin 7 of J1. It should be 5V during one sweep and 0V during the next. If these signals are not present, check the interconnect between the A27 and A29 PCBs via the A28 PCB. If this is proper, the A29U8 circuit is defective.

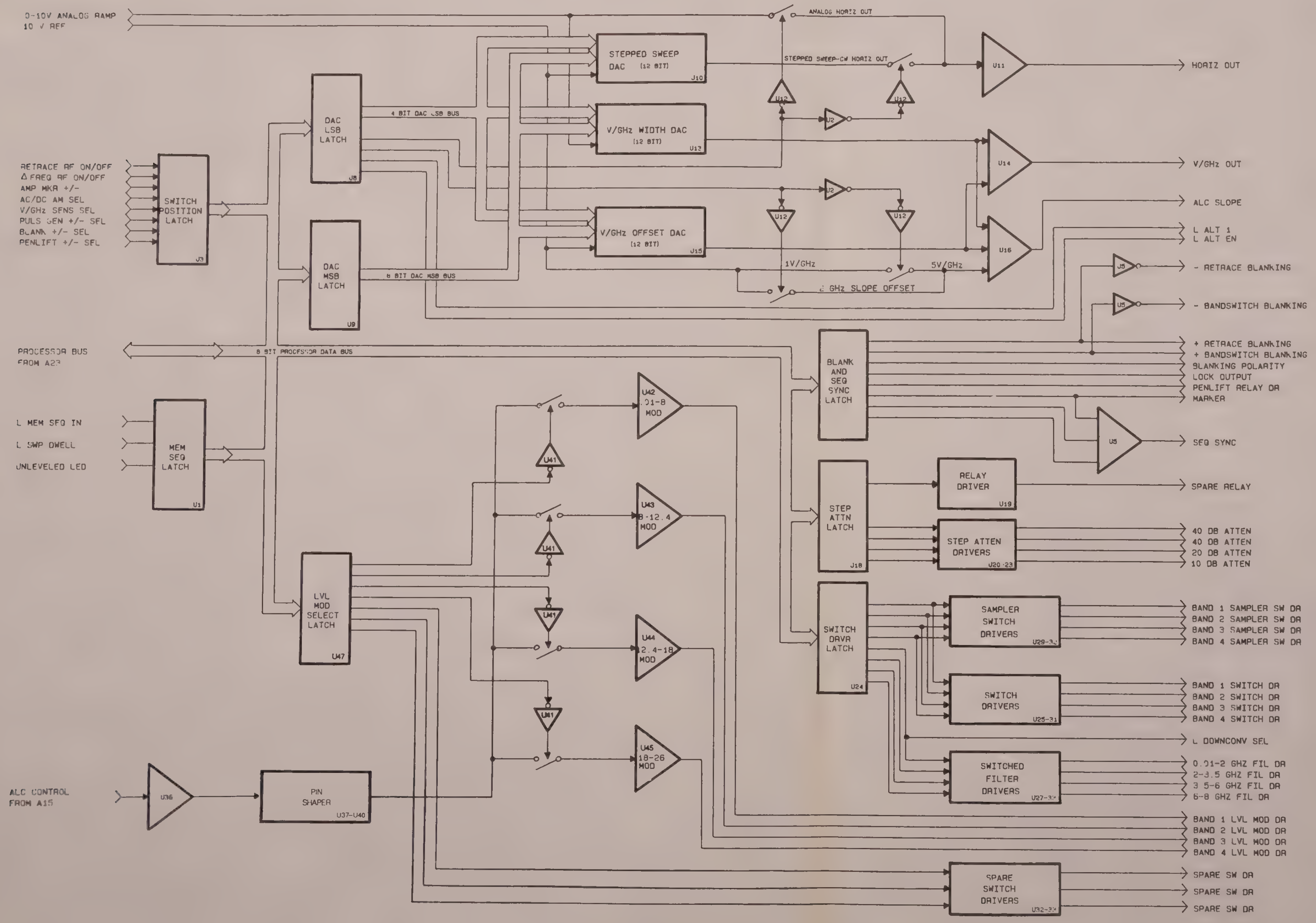
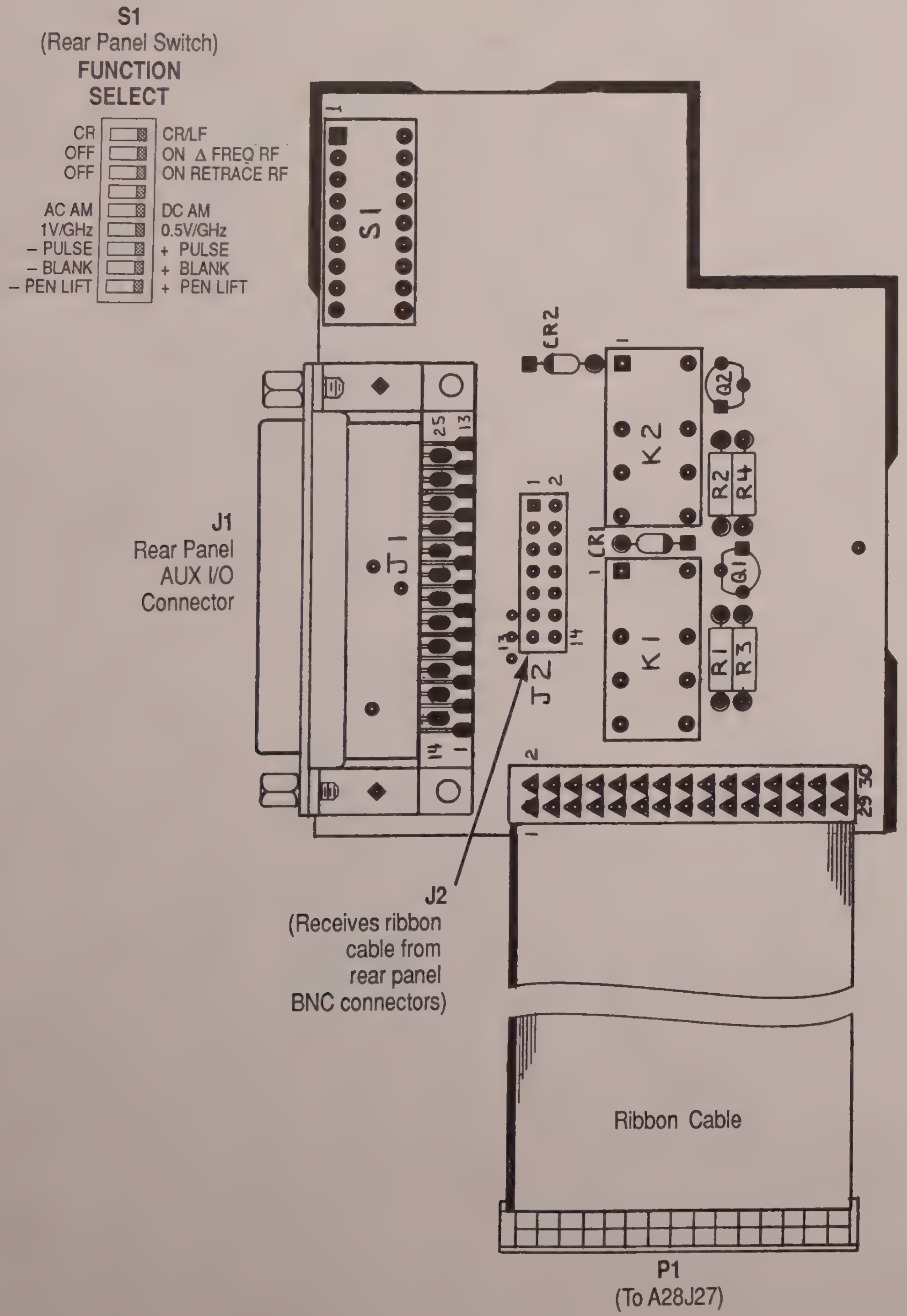

0-10V ANALOG RAMP
10 V REF
RETRACE RF ON/OFF
Δ FREQ RF ON/OFF
AMP MKR +/-
AC/DC AM SEL
V/GHz SENS SEL
PULS GEN +/- SEL
BLANK +/- SEL
PENLIFT +/- SEL
SWITCH POSITION LATCH
J3
DAC LSB LATCH
U8
DAC MSB LATCH
U9
4 BIT DAC LSB BUS
8 BIT DAC MSB BUS
PROCESSOR BUS FROM A23
8 BIT PROCESSOR DATA BUS
L MEM SEQ IN
L SWP DWELL
UNLEVELED LED
MEM SEQ LATCH
U1
STEPPED SWEEP DAC (12 BIT)
J10
V/GHz WIDTH DAC (12 BIT)
U13
V/GHz OFFSET DAC (12 BIT)
J15
ANALOG HORIZ OUT
STEPPED SWEEP-CW HORIZ OUT
U12
U2
1V/GHz
5V/GHz
GHz SLOPE OFFSET
U11
U14
U16
U5
HORIZ OUT
V/GHz OUT
ALC SLOPE
L ALT 1
L ALT EN
- RETRACE BLANKING
- BANDSWITCH BLANKING
+ RETRACE BLANKING
+ BANDSWITCH BLANKING
BLANKING POLARITY
LOCK OUTPUT
PENLIFT RELAY DR
MARKER
SEQ SYNC
BLANK AND SEQ SYNC LATCH
STEP ATTN LATCH
J18
RELAY DRIVER
U19
SPARE RELAY
STEP ATTEN DRIVERS
U20-23
40 DB ATTEN
40 DB ATTEN
20 DB ATTEN
10 DB ATTEN
SWITCH DRVR LATCH
U24
SAMPLER SWITCH DRIVERS
U29-32
BAND 1 SAMPLER SW DR
BAND 2 SAMPLER SW DR
BAND 3 SAMPLER SW DR
BAND 4 SAMPLER SW DR
SWITCH DRIVERS
U25-31
BAND 1 SWITCH DR
BAND 2 SWITCH DR
BAND 3 SWITCH DR
BAND 4 SWITCH DR
L DOWNCONV SEL
SWITCHED FILTER DRIVERS
U27-32
0.01-2 GHZ FIL DR
2-3.5 GHZ FIL DR
3 5-6 GHZ FIL DR
6-8 GHZ FIL DR
BAND 1 LVL MOD DR
BAND 2 LVL MOD DR
BAND 3 LVL MOD DR
BAND 4 LVL MOD DR
SPARE SWITCH DRIVERS
U32-34
SPARE SW DR
SPARE SW DR
SPARE SW DR
U41
U42 .01-8 MOD
U43 8-12.4 MOD
U44 12.4-18 MOD
U45 18-26 MOD
LVL MOD SELECT LATCH
U47
ALC CONTROL FROM A15
U36
PIN SHAPER
U37-U40

Figure 6F-2. A29 Rear Panel Interface PCB Block Diagram


S1
(Rear Panel Switch)
FUNCTION SELECT
CR
OFF
OFF
AC AM
1V/GHz
– PULSE
– BLANK
– PEN LIFT
CR/LF
ON Δ FREQ RF
ON RETRACE RF
DC AM
0.5V/GHz
+ PULSE
+ BLANK
+ PEN LIFT
S1
CR2
Q2
K2
R2
R4
CR1
Q1
K1
R1
R3
J1
J2
J1
Rear Panel
AUX I/O
Connector
J2
(Receives ribbon cable from rear panel BNC connectors)
Ribbon Cable
P1
(To A28J27)

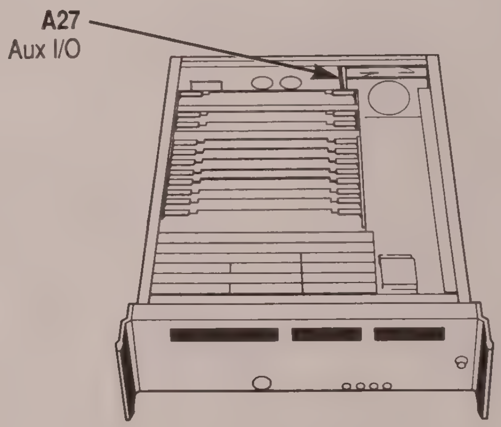
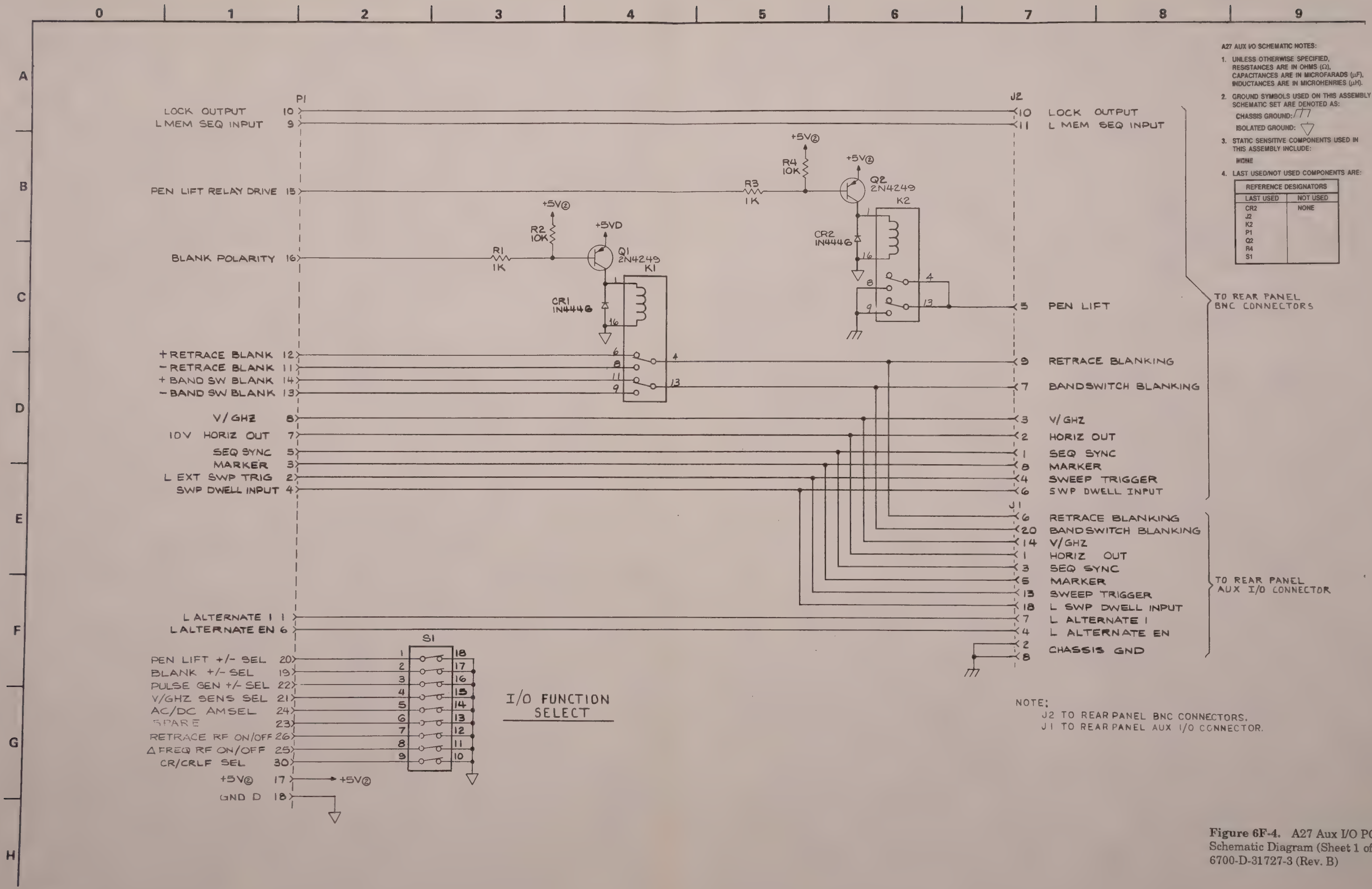


Figure 6F-3. A27 Aux I/O PCB Parts Locater Diagram
6700-D-31727-3 (Rev. B)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
P1
LOCK OUTPUT 10
L MEM SEQ INPUT 9
PEN LIFT RELAY DRIVE 15
BLANK POLARITY 16
+RETRACE BLANK 12
−RETRACE BLANK 11
+BAND SW BLANK 14
−BAND SW BLANK 13
V/GHZ 8
10V HORIZ OUT 7
SEQ SYNC 5
MARKER 3
L EXT SWP TRIG 2
SWP DWELL INPUT 4
L ALTERNATE 1 1
L ALTERNATE EN 6
PEN LIFT +/− SEL 20
BLANK +/− SEL 19
PULSE GEN +/− SEL 22
V/GHZ SENS SEL 21
AC/DC AMSEL 24
SPARE 23
RETRACE RF ON/OFF 26
△FREQ RF ON/OFF 25
CR/CRLF SEL 30
+5V② 17
+5V②
GND D 18
S1
1 2 3 4 5 6 7 8 9
18 17 16 15 14 13 12 11 10
I/O FUNCTION SELECT
R1 1K
+5V②
R2 10K
+5VD
Q1 2N4249
K1
CR1 1N4446
1 16 6 8 11 9 4 13
R3 1K
+5V②
R4 10K
+5V②
Q2 2N4249
K2
CR2 1N4446
1 16 8 9 4 13
J2
10 LOCK OUTPUT
11 L MEM SEQ INPUT
5 PEN LIFT
9 RETRACE BLANKING
7 BANDSWITCH BLANKING
3 V/GHZ
2 HORIZ OUT
1 SEQ SYNC
8 MARKER
4 SWEEP TRIGGER
6 SWP DWELL INPUT
TO REAR PANEL BNC CONNECTORS
J1
6 RETRACE BLANKING
20 BANDSWITCH BLANKING
14 V/GHZ
1 HORIZ OUT
3 SEQ SYNC
5 MARKER
13 SWEEP TRIGGER
18 L SWP DWELL INPUT
7 L ALTERNATE 1
4 L ALTERNATE EN
2 8 CHASSIS GND
TO REAR PANEL AUX I/O CONNECTOR

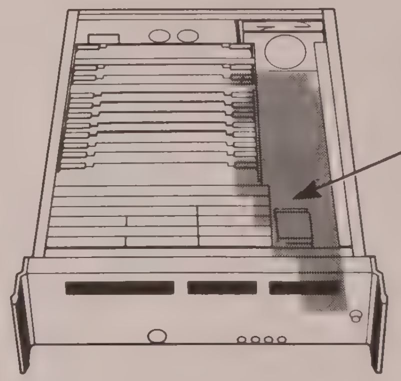
A27 AUX I/O SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏚
   ISOLATED GROUND: ▽
3. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   NONE
4. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
CR2 J2 K2 P1 Q2 R4 S1	NONE

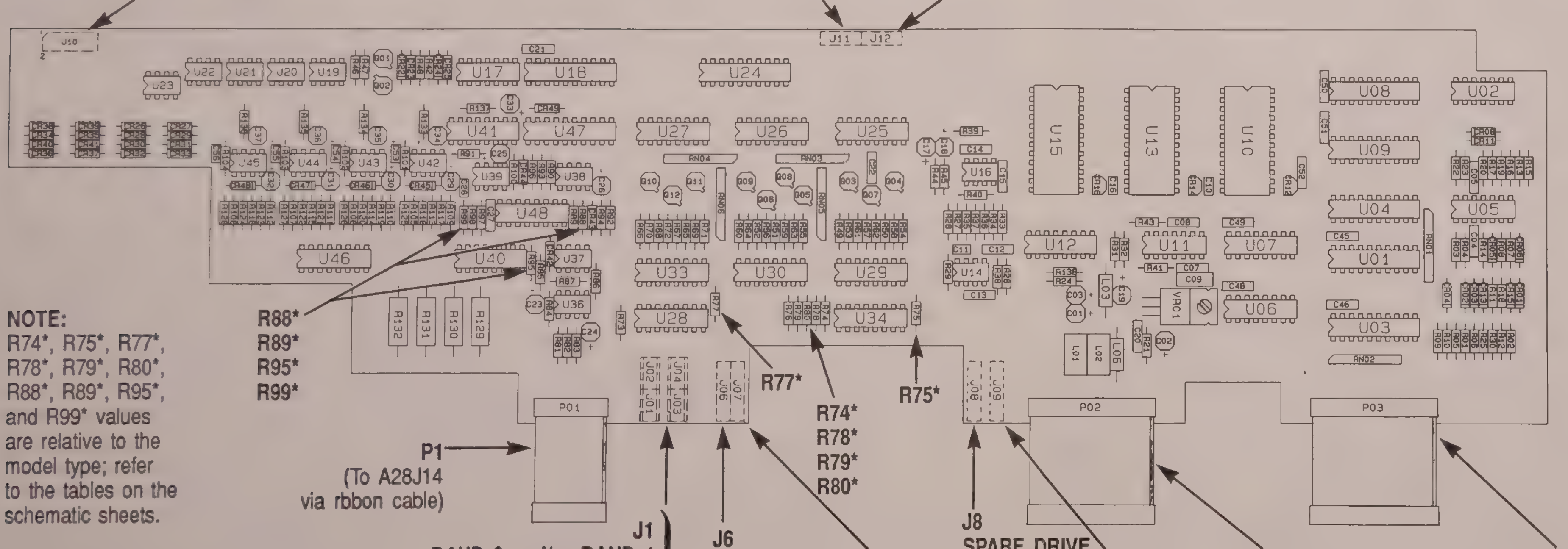
NOTE:
J2 TO REAR PANEL BNC CONNECTORS.
J1 TO REAR PANEL AUX I/O CONNECTOR.

Figure 6F-4. A27 Aux I/O PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31727-3 (Rev. B)



A29
REAR PANEL
INTERFACE
(Bottom Side)

A29 REAR PANEL INTERFACE
(As viewed from bottom of instrument)


J10
J11
J12
U23
U22
U21
U20
U19
U17
U18
C21
U24
U41
U47
U27
U26
U25
U15
U13
U10
U08
U02
U09
U45
U44
U43
U42
U39
U38
RN04
RN03
U16
U48
U04
U05
U46
U40
U37
U33
U30
U29
U12
U11
U07
U01
RN01
U14
VR01
U06
U03
R132
R131
R130
R129
U36
U28
U34
L01
L02
L03
L06
RN02
P01
P02
P03

J10
ATTENUATOR DRIVE
(Standard Units: To Optional Attenuator)
(6742A-C0044 Units: To Step Attenuator Terminus PCB)

J11
(Not Used)

J12
ATTENUATOR DRIVER
(Used in 6742A-C0044 units only)
(To Step Attenuator Terminus PCB)

R88*
R89*
R95*
R99*

R77*

R74*
R78*
R79*
R80*

R75*

P1
(To A28J14
via rbbon cable)

J1
BAND 0 and/or BAND 1
MOD DRVR

J2
BAND 2
MOD DRVR

J3
BAND 3 and/or BAND 5
MOD DRVR

J4
BAND 4
MOD DRVR

To RF Deck
Control Modulators

J6
SWITCH DRIVE
(Used in all
multi-band units)

J7
FILTER DRIVE
(Used in all units
having a 2-8 GHz band)

J8
SPARE DRIVE
(Not Used)

J9
SAMPLER SWITCH DRIVE
(Used in all multi-band
units except 6717A)

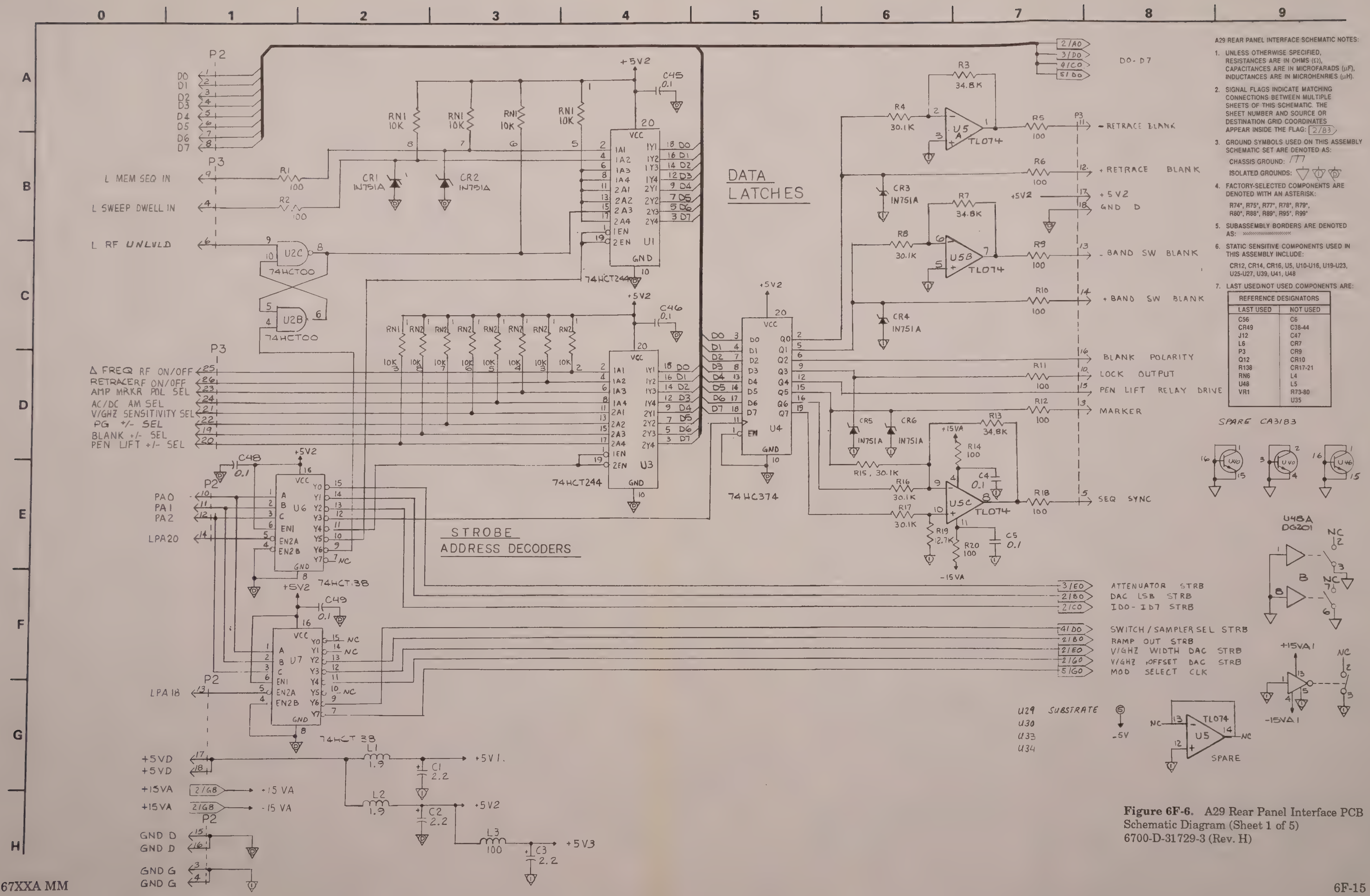
P2
(To A28J19
via ribbon cable)

P3
(To A28J23
via ribbon cable)

NOTE:
R74*, R75*, R77*, R78*, R79*, R80*, R88*, R89*, R95*, and R99* values are relative to the model type; refer to the tables on the schematic sheets.

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6F-5. A29 Rear Panel Interface PCB Parts Locater Diagram
6700-D-31729-3 (Rev. H)

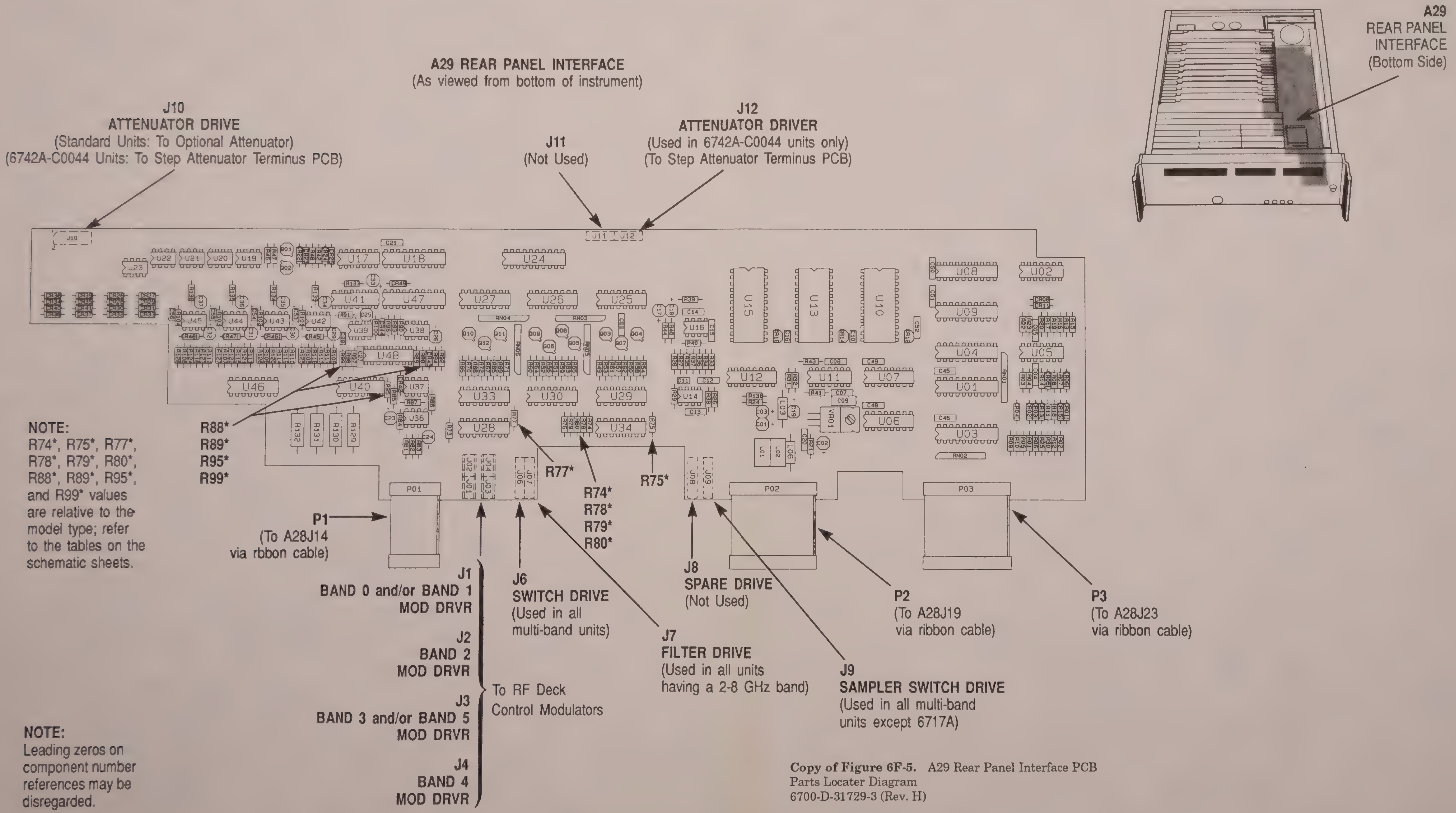

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
P2
D0
D1
D2
D3
D4
D5
D6
D7
P3
L MEM SEQ IN
L SWEEP DWELL IN
L RF UNLVLD
R1 100
R2 100
CR1 IN751A
CR2 IN751A
RN1 10K
+5V2
C45 0.1
U1
74HCT244
U2C
74HCT00
U2B
74HCT00
DATA LATCHES
Δ FREQ RF ON/OFF
RETRACERF ON/OFF
AMP MRKR POL SEL
AC/DC AM SEL
V/GHZ SENSITIVITY SEL
PG +/- SEL
BLANK +/- SEL
PEN LIFT +/- SEL
RN2 10K
C46 0.1
U3
74HCT244
U4
74HC374
C48 0.1
PA0
PA1
PA2
LPA20
U6
74HCT38
STROBE ADDRESS DECODERS
C49 0.1
U7
74HCT38
LPA18
NC
2/A0
3/D0
4/C0
5/D0
D0-D7
R3 34.8K
R4 30.1K
U5A
TL074
R5 100
- RETRACE BLANK
R6 100
+ RETRACE BLANK
CR3 IN751A
R7 34.8K
+5V2
GND D
R8 30.1K
U5B
TL074
R9 100
- BAND SW BLANK
R10 100
+ BAND SW BLANK
CR4 IN751A
BLANK POLARITY
R11 100
LOCK OUTPUT
PEN LIFT RELAY DRIVE
R12 100
MARKER
CR5 IN751A
CR6 IN751A
+15VA
R13 34.8K
R14 100
C4 0.1
R15, 30.1K
R16 30.1K
R17 30.1K
U5C
TL074
R18 100
SEQ SYNC
R19 12.7K
R20 100
C5 0.1
-15VA
3/E0
2/B0
2/C0
ATTENUATOR STRB
DAC LSB STRB
ID0-ID7 STRB
4/D0
2/B0
2/E0
2/G0
5/G0
SWITCH / SAMPLER SEL STRB
RAMP OUT STRB
V/GHZ WIDTH DAC STRB
V/GHZ OFFSET DAC STRB
MOD SELECT CLK
+5VD
+5VD
+15VA
+15VA
2/G8
- 15 VA
L1 1.9
C1 2.2
+5V1
L2 1.9
C2 2.2
+5V2
L3 100
C3 2.2
+5V3
GND D
GND D
GND G
GND G
SPARE CA3183
U40
U40
U46
U48A DG201
B
+15VA1
-15VA1
U29 SUBSTRATE
U30
U33
U34
-5V
U5
TL074
SPARE

A29 REAR PANEL INTERFACE SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUNDS:
4. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK:
   R74*, R75*, R77*, R78*, R79*, R80*, R88*, R89*, R95*, R99*
5. SUBASSEMBLY BORDERS ARE DENOTED AS:
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR12, CR14, CR16, U5, U10-U16, U19-U23, U25-U27, U39, U41, U48
7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C56	C6
CR49	C38-44
J12	C47
L6	CR7
P3	CR9
Q12	CR10
R138	CR17-21
RN6	L4
U48	L5
VR1	R73-80
	U35

Figure 6F-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 1 of 5)
6700-D-31729-3 (Rev. H)


J10
U23
U22
U21
U20
U19
U17
U18
U24
U41
U47
U27
U26
U25
U45
U44
U43
U42
U39
U38
U48
U46
U40
U37
U36
U33
U30
U29
U28
U34
U16
U14
U15
U13
U10
U12
U11
U07
U06
U08
U02
U09
U04
U05
U01
U03
VR01
R132
R131
R130
R129
J11
J12
J01
J02
J03
J04
J06
J07
J08
J09
P01
P02
P03

A29 REAR PANEL INTERFACE
(As viewed from bottom of instrument)

J10
ATTENUATOR DRIVE
(Standard Units: To Optional Attenuator)
(6742A-C0044 Units: To Step Attenuator Terminus PCB)

J11
(Not Used)

J12
ATTENUATOR DRIVER
(Used in 6742A-C0044 units only)
(To Step Attenuator Terminus PCB)

A29
REAR PANEL
INTERFACE
(Bottom Side)

NOTE:
R74*, R75*, R77*, R78*, R79*, R80*, R88*, R89*, R95*, and R99* values are relative to the model type; refer to the tables on the schematic sheets.

R88*
R89*
R95*
R99*

R77*

R74*
R78*
R79*
R80*

R75*

P1
(To A28J14
via rbbon cable)

J1
BAND 0 and/or BAND 1
MOD DRVR

J2
BAND 2
MOD DRVR

J3
BAND 3 and/or BAND 5
MOD DRVR

J4
BAND 4
MOD DRVR

To RF Deck
Control Modulators

J6
SWITCH DRIVE
(Used in all
multi-band units)

J7
FILTER DRIVE
(Used in all units
having a 2-8 GHz band)

J8
SPARE DRIVE
(Not Used)

J9
SAMPLER SWITCH DRIVE
(Used in all multi-band
units except 6717A)

P2
(To A28J19
via ribbon cable)

P3
(To A28J23
via ribbon cable)

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6F-5. A29 Rear Panel Interface PCB Parts Locater Diagram
6700-D-31729-3 (Rev. H)

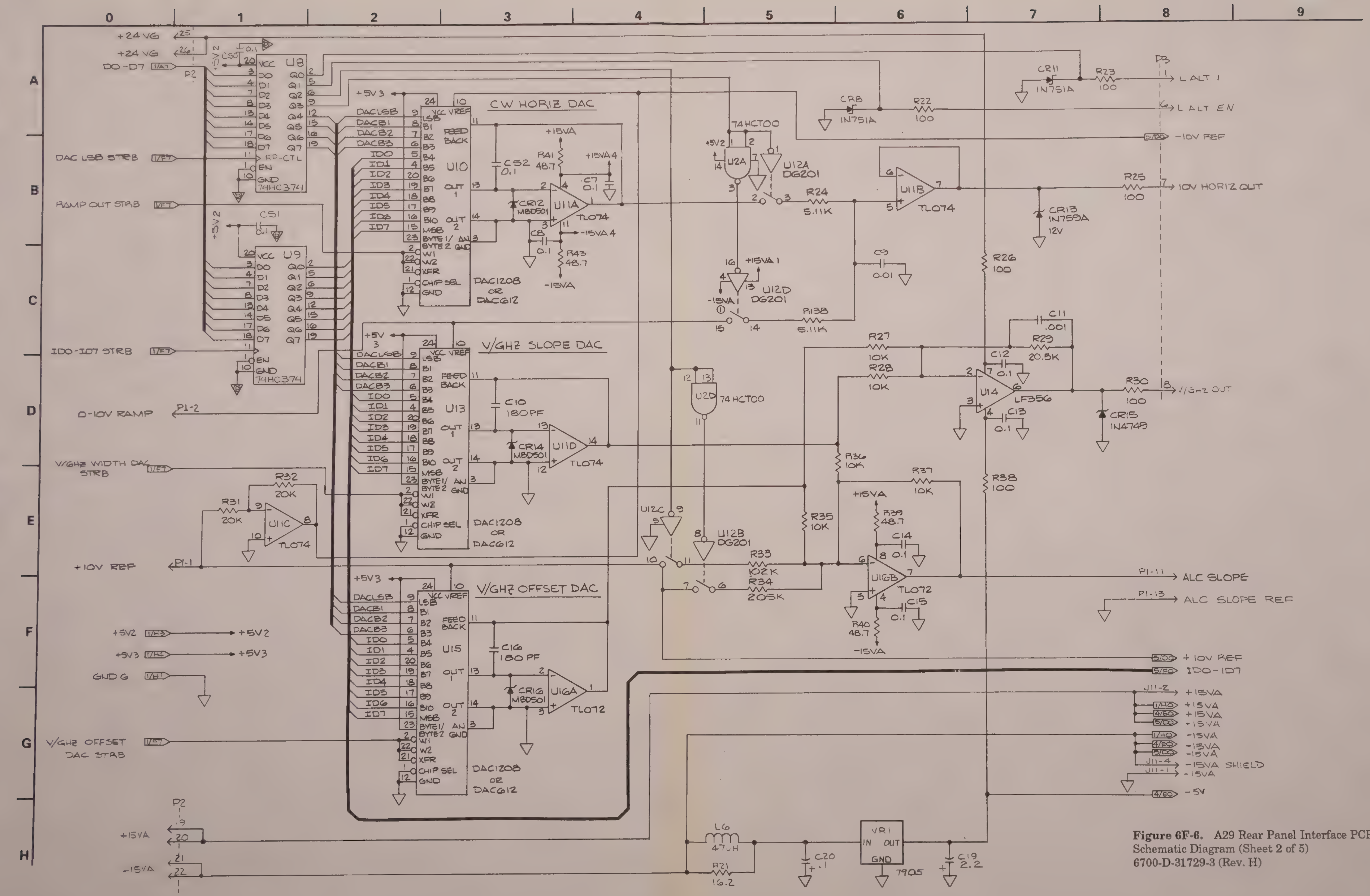
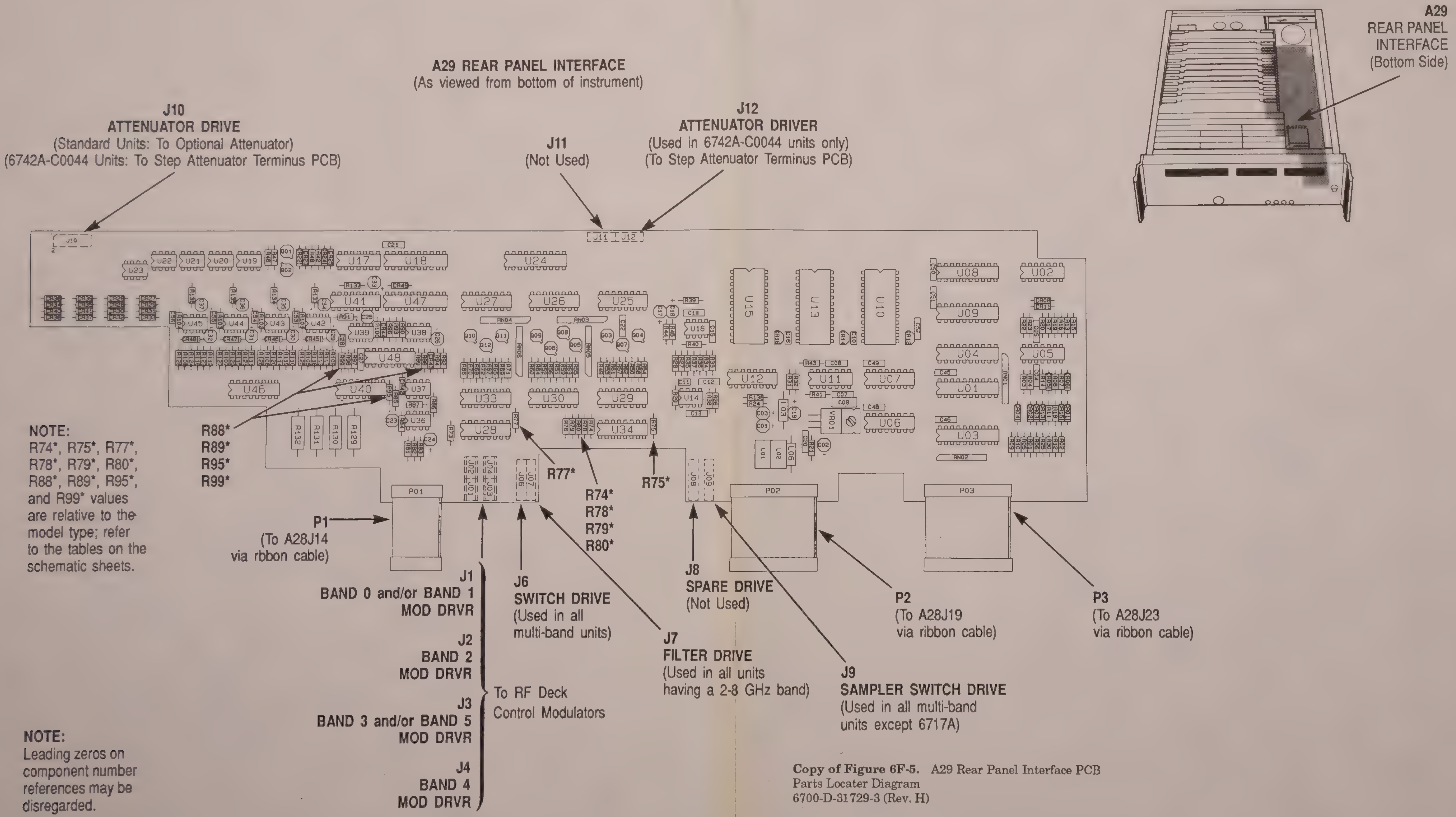

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
+24 VG
+24 VG
D0-D7
P2
+5V2
C50
0.1
U8
VCC
D0
D1
D2
D3
D4
D5
D6
D7
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
RP-CTL
EN
GND
74HC374
DAC LSB STRB
RAMP OUT STRB
C51
0.1
U9
IDO-ID7 STRB
74HC374
0-10V RAMP
P1-2
V/GHz WIDTH DAC STRB
R32
20K
R31
20K
U11C
TL074
+10V REF
P1-1
+5V3
DACLSB
DACB1
DACB2
DACB3
ID0
ID1
ID2
ID3
ID4
ID5
ID6
ID7
CW HORIZ DAC
U10
VCC VREF
LSB
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
MSB
BYTE 1/BYTE 2
W1
W2
XFR
CHIP SEL
GND
FEED BACK
OUT 1
OUT 2
AN GND
DAC1208 OR DAC612
C52
0.1
+15VA
R41
48.7
+15VA4
C7
0.1
CR12
MBD501
U11A
TL074
C8
0.1
-15VA4
R43
48.7
-15VA
V/GHz SLOPE DAC
U13
C10
180PF
CR14
MBD501
U11D
TL074
DAC1208 OR DAC612
V/GHz OFFSET DAC
U15
C16
180 PF
CR16
MBD501
U16A
TL072
DAC1208 OR DAC612
+5V2
+5V3
GND G
V/GHz OFFSET DAC STRB
P2
+15VA
-15VA
74HCT00
+5V2
U12A
U12A
DG201
R24
5.11K
+15VA 1
U12D
DG201
-15VA 1
R138
5.11K
U2D
74HCT00
U12C
U12B
DG201
R33
102K
R34
205K
CR11
1N751A
R23
100
P3
L ALT 1
CR8
1N751A
R22
100
L ALT EN
-10V REF
U11B
TL074
R25
100
10V HORIZ OUT
CR13
1N759A
12V
C9
0.01
R26
100
R27
10K
R28
10K
C11
.001
R29
20.5K
C12
0.1
U14
LF356
C13
0.1
R30
100
V/GHz OUT
CR15
1N4749
R36
10K
R37
10K
R38
100
R35
10K
+15VA
R39
48.7
C14
0.1
U16B
TL072
C15
0.1
R40
48.7
-15VA
P1-11
ALC SLOPE
P1-13
ALC SLOPE REF
+10V REF
ID0-ID7
J11-2
+15VA
+15VA
+15VA
+15VA
-15VA
-15VA
-15VA
J11-4
-15VA SHIELD
J11-1
-15VA
-5V
L6
47uH
R21
16.2
C20
.1
VR1
IN
OUT
GND
7905
C19
2.2

Figure 6F-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 2 of 5) 6700-D-31729-3 (Rev. H)


A29 REAR PANEL INTERFACE
(As viewed from bottom of instrument)
J10
ATTENUATOR DRIVE
(Standard Units: To Optional Attenuator)
(6742A-C0044 Units: To Step Attenuator Terminus PCB)
J11
(Not Used)
J12
ATTENUATOR DRIVER
(Used in 6742A-C0044 units only)
(To Step Attenuator Terminus PCB)
A29
REAR PANEL
INTERFACE
(Bottom Side)
U23
U22
U21
U20
U19
U17
U18
U24
U41
U47
U27
U26
U25
U45
U44
U43
U42
U39
U38
U48
U46
U40
U37
U36
U33
U30
U29
U28
U34
U16
U14
U15
U13
U10
U12
U11
U07
U06
U08
U02
U09
U04
U05
U01
U03
VR01
P01
P02
P03
R132
R131
R130
R129
R88*
R89*
R95*
R99*
R77*
R74*
R78*
R79*
R80*
R75*
P1
(To A28J14
via rbbon cable)
J1
BAND 0 and/or BAND 1
MOD DRVR
J2
BAND 2
MOD DRVR
J3
BAND 3 and/or BAND 5
MOD DRVR
J4
BAND 4
MOD DRVR
To RF Deck
Control Modulators
J6
SWITCH DRIVE
(Used in all
multi-band units)
J7
FILTER DRIVE
(Used in all units
having a 2-8 GHz band)
J8
SPARE DRIVE
(Not Used)
J9
SAMPLER SWITCH DRIVE
(Used in all multi-band
units except 6717A)
P2
(To A28J19
via ribbon cable)
P3
(To A28J23
via ribbon cable)

NOTE:
R74*, R75*, R77*, R78*, R79*, R80*, R88*, R89*, R95*, and R99* values are relative to the model type; refer to the tables on the schematic sheets.

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6F-5. A29 Rear Panel Interface PCB Parts Locater Diagram
6700-D-31729-3 (Rev. H)

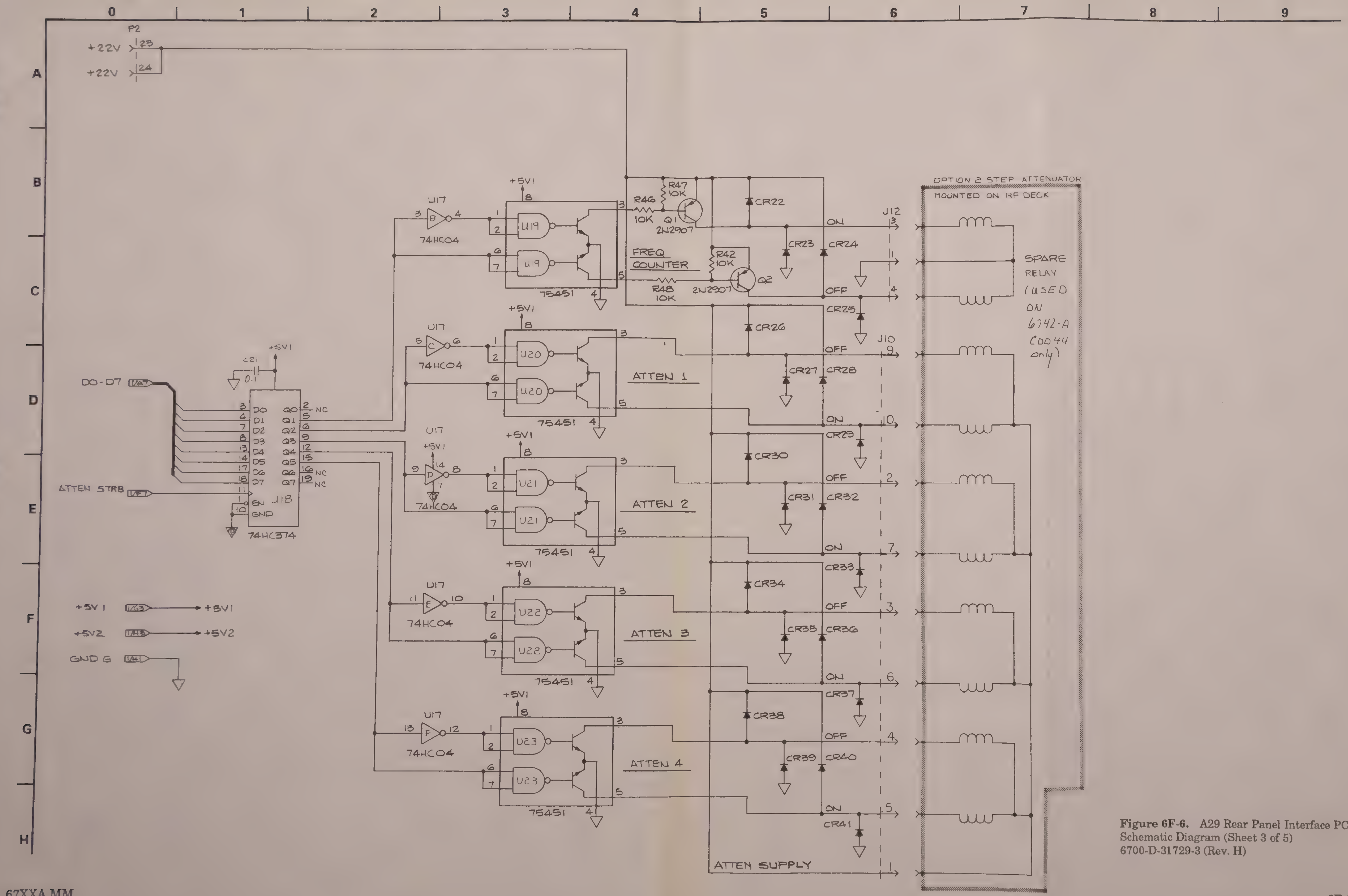
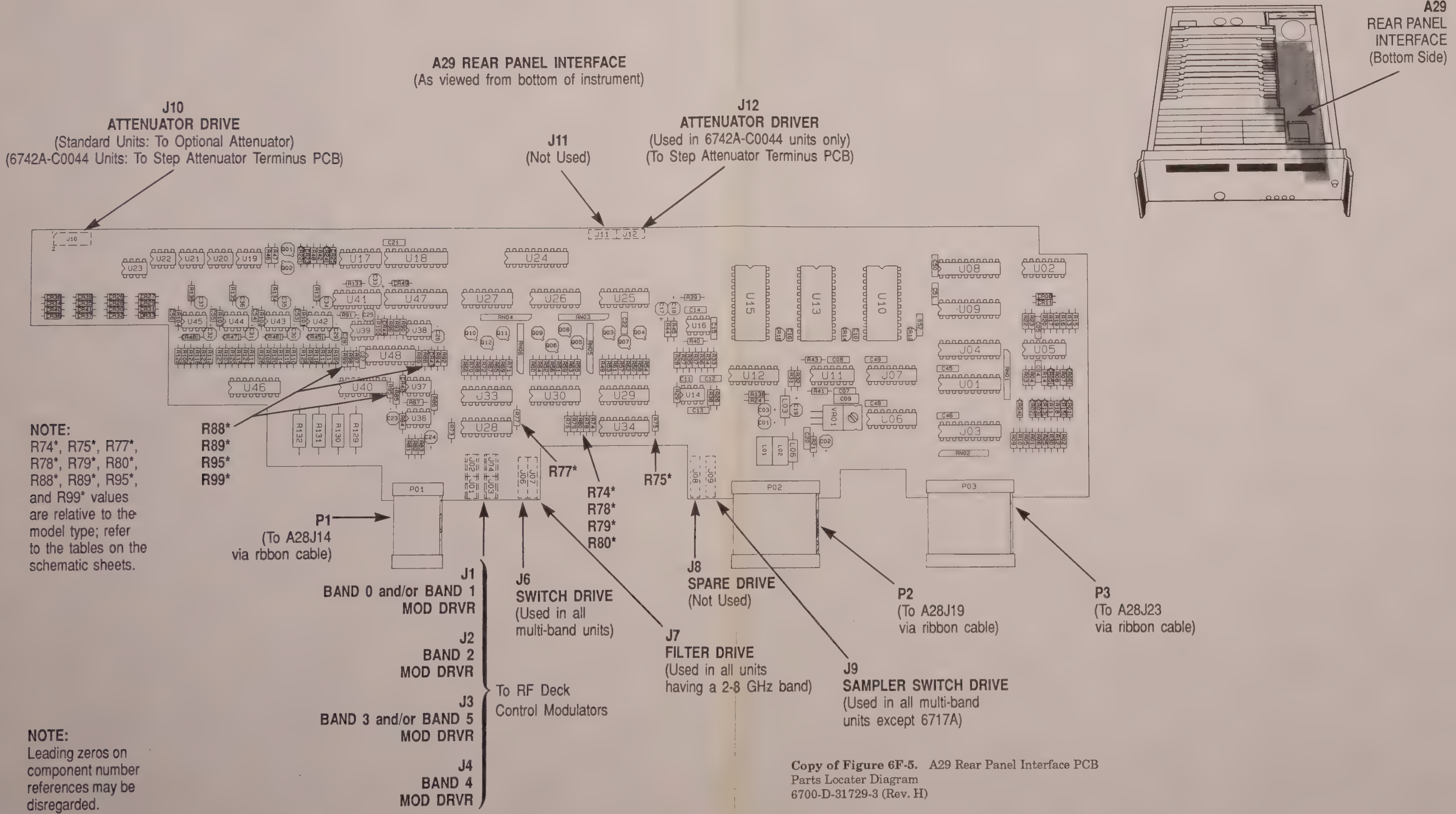

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
P2
+22V
23
24
+5V1
U17
74HC04
U19
U20
U21
U22
U23
75451
R46 10K
R47 10K
Q1 2N2907
R42 10K
R48 10K
Q2 2N2907
FREQ COUNTER
CR22
CR23
CR24
CR25
CR26
CR27
CR28
CR29
CR30
CR31
CR32
CR33
CR34
CR35
CR36
CR37
CR38
CR39
CR40
CR41
ON
OFF
J12
J10
ATTEN 1
ATTEN 2
ATTEN 3
ATTEN 4
ATTEN SUPPLY
C21 0.1
D0-D7
ATTEN STRB
J18
74HC374
D0
D1
D2
D3
D4
D5
D6
D7
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
EN
GND
NC
+5V1
+5V2
GND G
OPTION 2 STEP ATTENUATOR MOUNTED ON RF DECK
SPARE RELAY
(USED ON 6742-A C0044 only)

Figure 6F-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 3 of 5) 6700-D-31729-3 (Rev. H)


A29
REAR PANEL
INTERFACE
(Bottom Side)
A29 REAR PANEL INTERFACE
(As viewed from bottom of instrument)
J10
ATTENUATOR DRIVE
(Standard Units: To Optional Attenuator)
(6742A-C0044 Units: To Step Attenuator Terminus PCB)
J11
(Not Used)
J12
ATTENUATOR DRIVER
(Used in 6742A-C0044 units only)
(To Step Attenuator Terminus PCB)
U23
U22
U21
U20
U19
U17
U18
U24
U41
U47
U27
U26
U25
U45
U44
U43
U42
U39
U38
U48
U46
U40
U37
U36
U33
U30
U29
U28
U34
U16
U14
U15
U13
U10
U12
U11
U07
U08
U02
U09
U04
U05
U01
U06
U03
VR01
P01
P02
P03
R132
R131
R130
R129
R88*
R89*
R95*
R99*
R77*
R74*
R78*
R79*
R80*
R75*
P1
(To A28J14
via rbbon cable)
J1
BAND 0 and/or BAND 1
MOD DRVR
J2
BAND 2
MOD DRVR
J3
BAND 3 and/or BAND 5
MOD DRVR
J4
BAND 4
MOD DRVR
To RF Deck
Control Modulators
J6
SWITCH DRIVE
(Used in all
multi-band units)
J7
FILTER DRIVE
(Used in all units
having a 2-8 GHz band)
J8
SPARE DRIVE
(Not Used)
J9
SAMPLER SWITCH DRIVE
(Used in all multi-band
units except 6717A)
P2
(To A28J19
via ribbon cable)
P3
(To A28J23
via ribbon cable)

NOTE:
R74*, R75*, R77*, R78*, R79*, R80*, R88*, R89*, R95*, and R99* values are relative to the model type; refer to the tables on the schematic sheets.

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6F-5. A29 Rear Panel Interface PCB Parts Locater Diagram
6700-D-31729-3 (Rev. H)

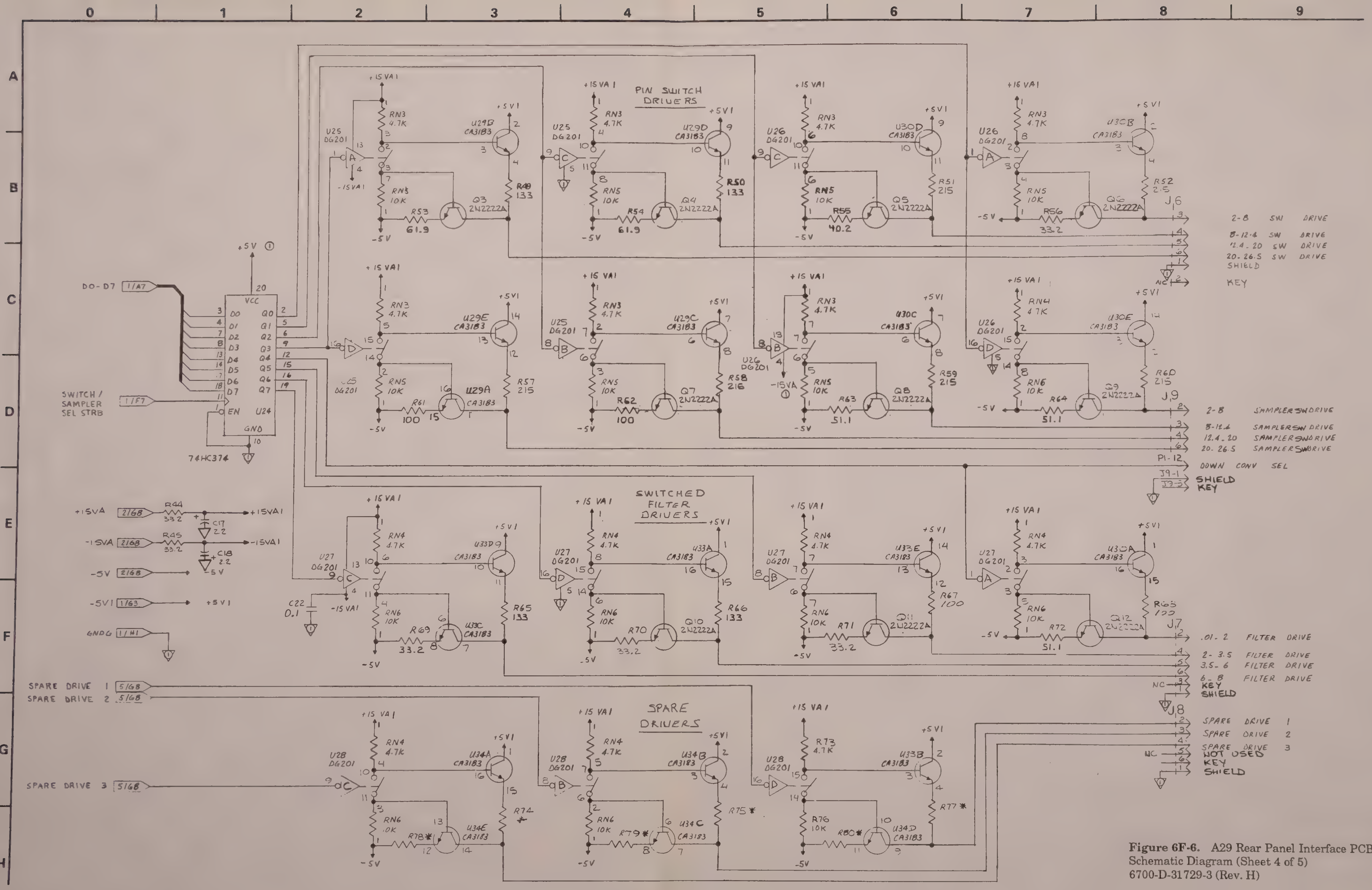
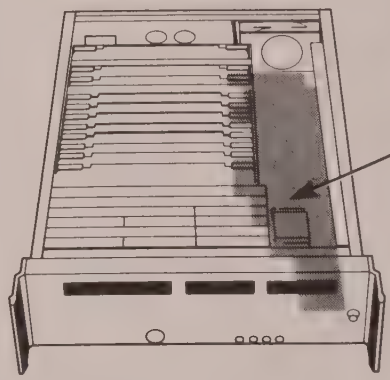

0 1 2 3 4 5 6 7 8 9
A B C D E F G H
PIN SWITCH DRIVERS
SWITCHED FILTER DRIVERS
SPARE DRIVERS
D0-D7 1/A7
SWITCH / SAMPLER SEL STRB 1/F7
74HC374
U24
+5V ①
+15VA 2/G8
-15VA 2/G8
-5V 2/G8
-5V1 1/G3
GNDG 1/H1
R44 33.2
R45 33.2
C17 2.2
C18 2.2
C22 0.1
+15VA1
-15VA1
+5V1
SPARE DRIVE 1 5/G8
SPARE DRIVE 2 5/G8
SPARE DRIVE 3 5/G8
U25 DG201
U26 DG201
U27 DG201
U28 DG201
RN3 4.7K
RN4 4.7K
RN5 10K
RN6 10K
U29B CA3183
U29D CA3183
U30D CA3183
U30B CA3183
U29E CA3183
U29C CA3183
U30C CA3183
U30E CA3183
U29A CA3183
U33D CA3183
U33A CA3183
U33E CA3183
U30A CA3183
U33C CA3183
U34A CA3183
U34B CA3183
U33B CA3183
U34E CA3183
U34C CA3183
U34D CA3183
Q3 2N2222A
Q4 2N2222A
Q5 2N2222A
Q6 2N2222A
Q7 2N2222A
Q8 2N2222A
Q9 2N2222A
Q10 2N2222A
Q11 2N2222A
Q12 2N2222A
R48 133
R50 133
R51 215
R52 215
R53 61.9
R54 61.9
R55 40.2
R56 33.2
R57 215
R58 216
R59 215
R60 215
R61 100
R62 100
R63 51.1
R64 51.1
R65 133
R66 133
R67 100
R68 100
R69 33.2
R70 33.2
R71 33.2
R72 51.1
R73 4.7K
R74*
R75*
R76 10K
R77*
R78*
R79*
R80*
J6
2-8 SW DRIVE
8-12.4 SW DRIVE
12.4-20 SW DRIVE
20-26.5 SW DRIVE
SHIELD
KEY
J9
2-8 SAMPLER SW DRIVE
8-12.4 SAMPLER SW DRIVE
12.4-20 SAMPLER SW DRIVE
20-26.5 SAMPLER SW DRIVE
P1-12 DOWN CONV SEL
J9-1 SHIELD
J9-5 KEY
J7
.01-2 FILTER DRIVE
2-3.5 FILTER DRIVE
3.5-6 FILTER DRIVE
6-8 FILTER DRIVE
KEY
SHIELD
J8
SPARE DRIVE 1
SPARE DRIVE 2
SPARE DRIVE 3
NOT USED
KEY
SHIELD
NC

Figure 6F-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 4 of 5)
6700-D-31729-3 (Rev. H)



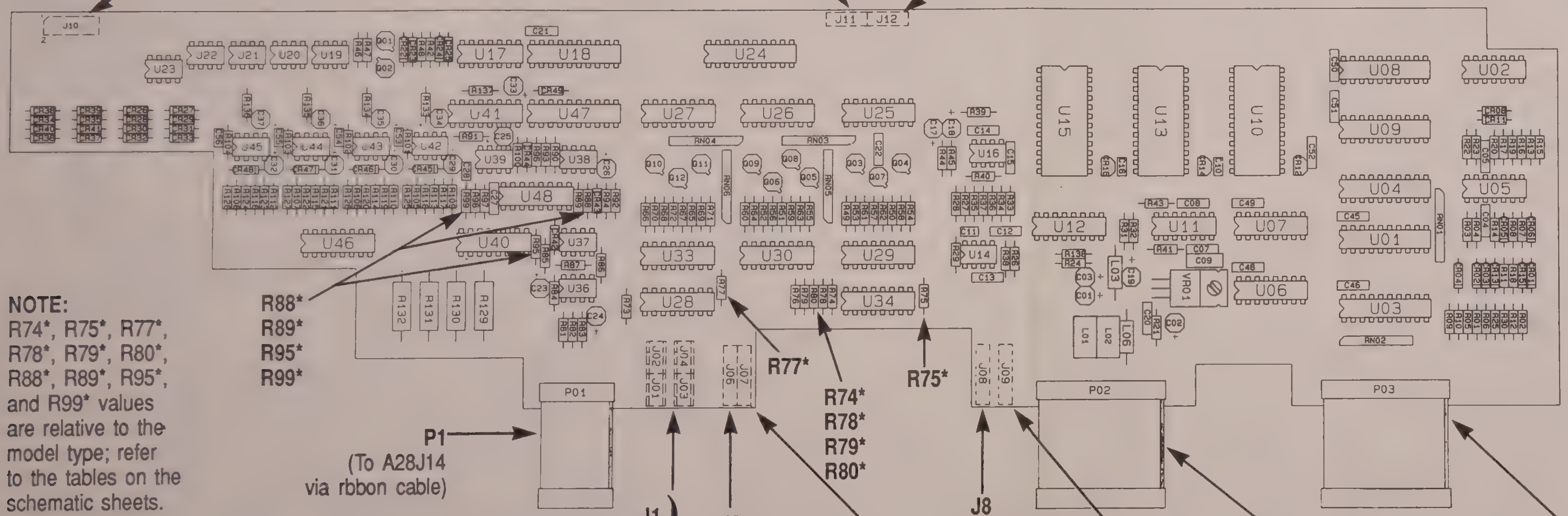
A29
REAR PANEL
INTERFACE
(Bottom Side)

A29 REAR PANEL INTERFACE
(As viewed from bottom of instrument)

J10
ATTENUATOR DRIVE
(Standard Units: To Optional Attenuator)
(6742A-C0044 Units: To Step Attenuator Terminus PCB)

J11
(Not Used)

J12
ATTENUATOR DRIVER
(Used in 6742A-C0044 units only)
(To Step Attenuator Terminus PCB)


J10
J11
J12
U23
U22
U21
U20
U19
U17
U18
C21
U24
U41
U47
U27
U26
U25
U45
U44
U43
U42
U39
U38
RN04
RN03
U48
U46
U40
U37
U36
U33
U30
U29
U28
U34
R132
R131
R130
R129
U15
U13
U10
U16
U12
U11
U07
U14
VR01
U06
L01
L02
L06
U08
U02
U09
U04
U05
U01
U03
RN02
J02
J01
J04
J03
J06
J07
J08
J09
P01
P02
P03

NOTE:
R74*, R75*, R77*, R78*, R79*, R80*, R88*, R89*, R95*, and R99* values are relative to the model type; refer to the tables on the schematic sheets.

R88*
R89*
R95*
R99*

R77*

R74*
R78*
R79*
R80*

R75*

P1
(To A28J14
via rbbon cable)

J1
BAND 0 and/or BAND 1
MOD DRVR

J2
BAND 2
MOD DRVR

J3
BAND 3 and/or BAND 5
MOD DRVR

J4
BAND 4
MOD DRVR

To RF Deck
Control Modulators

J6
SWITCH DRIVE
(Used in all
multi-band units)

J7
FILTER DRIVE
(Used in all units
having a 2-8 GHz band)

J8
SPARE DRIVE
(Not Used)

J9
SAMPLER SWITCH DRIVE
(Used in all multi-band
units except 6717A)

P2
(To A28J19
via ribbon cable)

P3
(To A28J23
via ribbon cable)

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6F-5. A29 Rear Panel Interface PCB Parts Locater Diagram
6700-D-31729-3 (Rev. H)

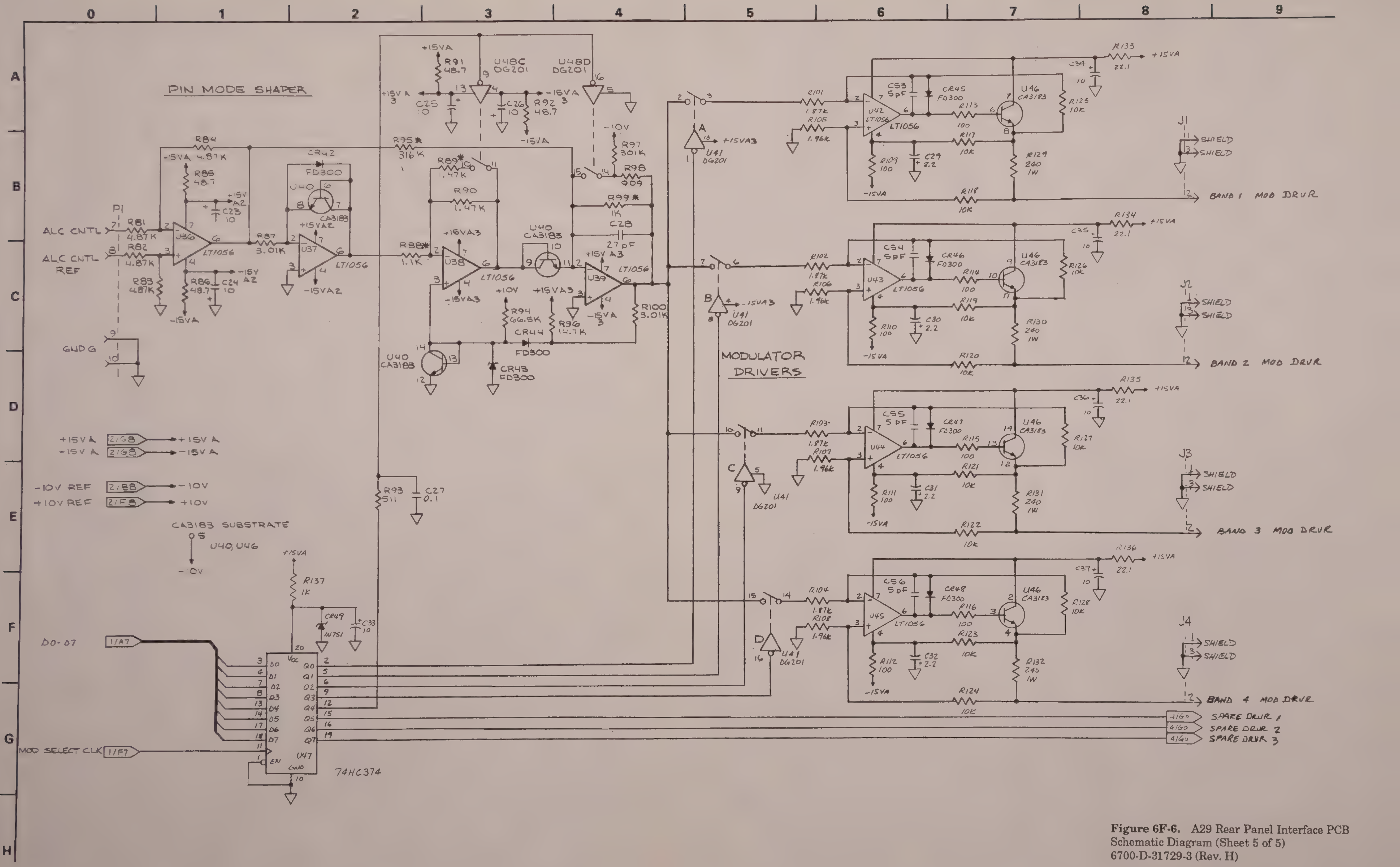

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
PIN MODE SHAPER
MODULATOR DRIVERS
P1
ALC CNTL
ALC CNTL REF
GND G
R81 4.87K
R82 4.87K
R83 487K
R84 4.87K
R85 48.7
R86 48.7
C23 10
C24 10
U36 LT1056
R87 3.01K
U37 LT1056
CR42 FD300
U40 CA3183
R88* 1.1K
U38 LT1056
R89* 1.47K
R90 1.47K
R91 48.7
R92 48.7
C25 10
C26 10
U48C DG201
U48D DG201
R95* 316K
R97 301K
R98 909
R99* 1K
C28 27pF
U39 LT1056
R94 66.5K
R96 14.7K
R100 3.01K
CR44 FD300
CR43 FD300
R93 511
C27 0.1
+15VA
-15VA
+15VA2
-15VA2
+15VA3
-15VA3
-10V
+10V
+15V A 2/G8 +15V A
-15V A 2/G8 -15V A
-10V REF 2/B8 -10V
+10V REF 2/F8 +10V
CA3183 SUBSTRATE
U40, U46
R137 1K
CR49 1N751
C33 10
D0-D7 1/A7
MOD SELECT CLK 1/F7
U47 74HC374
U41 DG201
R101 1.87K
R105 1.96K
U42 LT1056
C53 5pF
CR45 FD300
R113 100
R117 10K
R109 100
C29 2.2
U46 CA3183
R125 10K
R129 240 1W
R118 10K
R133 22.1
C34 10
J1
SHIELD
BAND 1 MOD DRVR
R102 1.87K
R106 1.96K
U43 LT1056
C54 5pF
CR46 FD300
R114 100
R119 10K
R110 100
C30 2.2
R126 10K
R130 240 1W
R120 10K
R134 22.1
C35 10
J2
BAND 2 MOD DRVR
R103 1.87K
R107 1.96K
U44 LT1056
C55 5pF
CR47 FD300
R115 100
R121 10K
R111 100
C31 2.2
R127 10K
R131 240 1W
R122 10K
R135 22.1
C36 10
J3
BAND 3 MOD DRVR
R104 1.87K
R108 1.96K
U45 LT1056
C56 5pF
CR48 FD300
R116 100
R123 10K
R112 100
C32 2.2
R128 10K
R132 240 1W
R124 10K
R136 22.1
C37 10
J4
BAND 4 MOD DRVR
4/G0 SPARE DRVR 1
4/G0 SPARE DRVR 2
4/G0 SPARE DRVR 3

Figure 6F-6. A29 Rear Panel Interface PCB Schematic Diagram (Sheet 5 of 5) 6700-D-31729-3 (Rev. H)

6G – REFERENCE LOOP: A5, A7, A10 PCBs AND CRYSTAL OSCILLATOR

6G-1 REFERENCE LOOP ASSEMBLIES: A5, A7, A10 PCBs and Crystal Oscillator

This section contains service information for the reference loop assemblies listed in Table 6G-1 below. Refer also to the general reference information in sections 6A, 6B, and 6C.

Table 6G-1. Reference Loop Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6G-2	6G-1
Block Diagram	Fig. 6G-1	6G-9
Troubleshooting	Tbl. 6G-2	6G-5
PCB LEVEL		
A5 Reference Oscillator PCB		
Detailed Circuit Description	Para. 6G-3	6G-4
Troubleshooting	Tbl. 6G-2	6G-5
Parts Locator Diagram	Fig. 6G-2	6G-10
Schematic (Sheet 1 of 1)	Fig. 6G-3	6G-11
Parts Locator Diagram*	Fig. 6G-4	6G-12
Schematic (Sheet 1 of 1)*	Fig. 6G-5	6G-13
* Newer Version		
A7 Reference Divider PCB		
Detailed Circuit Description	Para. 6G-4	6G-2
Troubleshooting	Tbl. 6G-2	6G-5
Parts Locator Diagram	Fig. 6G-6	6G-14
Schematic (Sheet 1 of 1)	Fig. 6G-7	6G-15
A10 Reference Buffer PCB		
Detailed Circuit Description	Para. 6G-5	6G-4
Troubleshooting	Tbl. 6G-2	6G-5
Parts Locator Diagram	Fig. 6G-8	6G-16
Schematic (Sheet 1 of 1)	Fig. 6G-9	6G-17

6G-2 REFERENCE LOOP ASSEMBLIES, OVERALL DESCRIPTION

Refer to the block diagram in Figure 6G-1 for the following discussion.

The Reference Loop is comprised of the 10 MHz Crystal Oscillator Assembly, the A5 Reference Oscillator PCB, the A7 Reference Divider PCB, and the A10 Reference Buffer PCB. The function of the Reference Loop is to translate the frequency accuracy and stability of the 10 MHz reference signal (from the internal crystal reference or an external synthesized source) to the A4 Coarse Loop Oscillator PCB, the A9 Fine Loop Oscillator PCB, the 0.01-2 GHz Down Converter, and the A13 Pulse Generator.

The 500 MHz surface-acoustical-wave (SAW) oscillator on the A5 PCB is applied to three buffer amplifiers which provide isolation between the A6 Coarse Loop Divider PCB, the A7 Reference Divider PCB, and the Down Converter. The 500 MHz applied to the A7 Reference Divider PCB is divided by 10 and then divided by 5. (The 50 MHz resulting from the divide by 10 is also buffered and applied to an output reserved for future use.). The 10 MHz resulting from the divide-by-5 is applied to the A7 PCB's phase/frequency detector and to a buffer amp which drives the A10 Reference Buffer PCB.

The internal 10 MHz crystal reference and the external 10 MHz reference (when used) are applied to buffer amplifiers and then to the Reference Select Logic. The presence of an external reference is detected by this control logic and automatically switches the output to the reference phase detector. When an external reference is used, the control logic also supplies a signal to turn off the internal 10 MHz oscillator and to tell the A23 Microprocessor PCB to illuminate the EXT REF message on the front panel FREQUENCY display. The 10 MHz from the dividers on the A7 PCB is compared with the 10 MHz from the internal or external reference resulting in a + or – phase error. This is applied to the loop amplifier that controls the frequency of the 500 MHz SAW oscillator. This corrects for any drift of the SAW oscillator due to time and temperature.

The output of the phase detector is zero when the SAW oscillator is phase locked. This output is also monitored by the A23 Microprocessor PCB to detect an unlocked condition that is then shown (1) as an error code during self test, and (2) by the illumination of the NOT Ø - LOCKED LED on the front panel.

(There are several Reasons for the NOT Ø - LOCKED LED to be illuminated. If it is illuminated when it should not be, that is in CW or Stepped Sweep modes, a self test indicates the area causing the unlocked condition.)

In addition to the phase lock monitor, the output of the loop amplifier is monitored by the A23 Microprocessor PCB via the DVM circuits on the A17 Analog Instruction PCB. This is displayed on the LEVEL DISPAY as a voltage for use in calibration of the SAW oscillator's center frequency.

6G-3 A5 REFERENCE OSCILLATOR, DETAILED CIRCUIT DESCRIPTION

Refer to the A5 PCB schematic diagram in Figure 6G-3 for the following discussion.

6G-3.1 Loop Amplifier

The A7 Reference Divider PCB phase error signal goes to the differential receiver/loop amplifier U1. U1 has a very high gain at dc; the gain decreases as the input frequency increases (controlled by R6 and C5). R5 and C4, in the other input leg of the amplifier, have the same values as R6 and C5. This allows U1 to act as a true differential receiver. The differential receiver action rejects common mode signals on the two inputs.

The positive (+) supply of U1 goes to the +24V supply via decoupling network R7 and C3. Since U1 can operate only from a total of 30 Vp-p, the negative terminal goes to a –5.6V supply. R11, C7, and CR2 provide the –5.6V for U1. CR1 limits the output swing of U1 to –0.6V to prevent forward biasing the varactor diode CR3.

R8, R9, and R10 (which are factory selected) provide a voltage divider from +24V to the output voltage of U1. This gives the proper voltage range for the tuning varactor diode CR3. The output swing of U1 is from approximately –0.6V to +22V. The voltage swing at the junction of R9, R10, and R12 is approximately +23V to +6V.

R13 and R14 divide the output voltage of U1 by approximately 2.77V so that it can be monitored by the DVM circuit on the A17 Analog Instruction PCB. This is used for self test and for troubleshooting purposes. When SHIFT, TRIGGER, 010 is pressed, the LEVEL display on the front panel indicates the divided voltage. It is used for centering the frequency of the SAW oscillator, Y1, to the tuning voltage. The A23 Microprocessor PCB applies the proper multiplication factor to correct for the voltage divider action of R13 and R14.

6G-3.2 Oscillator

The SAW resonator, in conjunction with CR3 and the printed circuit inductor, is the frequency determining component for Q2. The output of Q2 goes to a low pass filter network consisting of C9-15 and some printed circuit inductors. This low pass filter network provides the necessary 180 degree phase shift to sustain oscillation.

The output of Q2 is coupled to the base of Q3 via a wire jumper coupling loop W1. The coupling loop configuration decreases the load on Q3, thereby increasing the Q of the circuit. (The SAW resonator itself has a Q of 7,000.) R19 and R20 provide the bias for Q3. The output of Q3 goes to three buffer amplifiers that prevent the reflection of signals from external devices to the SAW oscillator. They also prevent the signals from coupling to the other outputs and causing spurious responses.

6G-3.3 Buffer Amplifiers

The three buffer amps, Q1, Q4, and Q5, are all configured the same, however, their biases are slightly different to provide the necessary output signal levels.

R37 is adjusted for the proper input power to the Down Converter.

Q6 and Q7 are capacitance multipliers that filter the 15V supplies from the A22 Regulator PCB. They multiply the base capacitance by the beta of the transistor and provide about 40 dB rejection of noise and ripple on the power supplies.

6G-4 A7 REFERENCE DIVIDER PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the A7 PCB schematic diagram in Figure 6G-5 for the following discussion.

6G-4.1 500 MHz Input

The 500 MHz from A5 goes to impedance matching network R1, R2, and R3. From there it goes to a buffer amplifier Q1 and is coupled by C3 to a divide-by-10 integrated circuit U1. The 50 MHz TTL output of U1 goes to two divide-by-5 circuits, U3 and U4, and buffer amplifier Q7. (Q7 provides isolation from the connector reserved for future use.)

6G-4.2 Divide-by-Five

U3, U4, and part of U2 comprise a divide-by-five circuit that drops the frequency from 50 MHz to 10 MHz and applies it to the U6 phase detector circuit, which operates at 10 MHz.

6G-4.3 10 MHz Input Circuit

In order to convert its sine wave to a TTL level, the crystal oscillator inputs 10 MHz to a buffer amplifier and squaring circuit Q8. CR7 acts as a switch for the bias current of Q8, which is furnished by R13. CR8 prevents saturation of Q8. The output of Q8 goes to NAND gate U5. Normally, U5-12 functions at a TTL high, so U5 inverts the 10 MHz input. From U5-11, the 10 MHz goes to U5-4 which also has a TTL high on pin 5. The output of U5-6 then goes to the U6 phase/frequency comparator.

6G-4.4 External 10 MHz Input Circuit

If a 10 MHz signal is present at J4, it goes to buffer amplifier Q4 which converts it to TTL levels and applies it to U5-10. The output of Q4 also goes to CR5 and CR6, which are configured as a full-wave rectifier. The dc output of the rectifier turns on Q5, pulling the collector to ground. This ground signal disables U5, causing its output at pin 11 to go to a TTL high. U2C inverts the ground signal from Q5 and applies a TTL high to U5-9. This enables the 10 MHz from the rear panel to go to the phase detector via U5B. The TTL high also goes to P1 and then to the A8 Serial I/O PCB via the A28 Motherboard PCB. The A23 Microprocessor PCB reads the signal during housekeeping routines (approximately every 50 ms). It then instructs the front panel to activate the EXT REF annunciator on the FREQUENCY display via the A8 Serial I/O and A2 Front Panel Control PCBs. The signal from U2C also turns on Q6. The collector of Q6 goes to the internal 10 MHz crystal oscillator via the A28 Motherboard PCB and pulls the line to ground. It then shuts off the internal 10 MHz oscillator to prevent spurious responses. The output of the divide-by-five goes to the Q3 buffer amplifier as well as the phase detector. From Q3, the 10 MHz goes to the A10 Reference Buffer. The rest of the instrument uses this 10 MHz signal for reference.

NOTE

This 10 MHz comes from the 500 MHz reference oscillator and is not the same 10 MHz signal that comes from the internal 10 MHz crystal oscillator. When the SAW oscillator is unlocked, the 10 MHz reference for the rest of the instrument is off frequency by the same percentage as the 500 MHz is from its locked frequency. When the unlocked SAW is 50 kHz high, the 10 MHz at A5J3 is 10 kHz high (50 kHz/50). Although the Reference Loop is unlocked, the Coarse, Fine, and YIG Loops still lock, but at a corresponding frequency offset. For example, when the 500 MHz oscillator is 50 kHz high, the locked Fine Loop Oscillator is 20 kHz high at 200 MHz. Under the above conditions, the Coarse Loop is 40 kHz high when locked at 400 MHz.

6G-4.5 Phase/Frequency Detector

U5A and U6 comprise a "D" flip-flop phase/frequency detector. When the 10 MHz signals at U6-1 and U6-13 are in phase, the rising edges transfer the +5V on pins 3 and 11 to the output pins 5 and 9. Since pins 1 and 2 of U5A go high at the same time, U5A-3 goes low and clears U6A and U6B, setting their Q output low again. This causes a pulse of approximately 20 ns (due to the propagation delay of U5A and U6) at pins 5 and 9 of U6

When the 10 MHz clock at U6-1 is delayed by 90 degrees (25 ns at 10 MHz), U5A-1 goes high 25 ns after U5A-2. This results in a pulse of approximately 45 ns at U6-9 and a 20 ns pulse at U6-5. When the 10 MHz clock at U6-1 is ahead by 90 degrees, U6-5 has the 45 ns pulse and U6-9 has the 20 ns pulse.

R23-C19 and R25-C20 integrate the outputs of U6, which go to the differential receiver (U7). If one of the outputs of U6 has a wider pulse than the other, the dc voltage resulting from the integration of that pulse will be higher than the dc voltage resulting from the narrow pulse. U17 amplifies this dc voltage difference, which then goes to the loop amplifier on the A5 Reference Oscillator PCB.

Because the phase lock loop corrects the frequency until there is zero phase difference, the output from U7 is 0V when the Reference Loop is phase locked. When the loop is unlocked, the phase detector has maximum output and the output from U7 is approximately ±12V.

The output of U7 also goes to a decoupling network for the phase detector (R37, C22, and R39) before it goes to the DVM circuit on the A17 Analog Instruction PCB. The A23 Microprocessor PCB monitors this point via the A17 PCB DVM circuit to determine if the Reference Loop is locked or not.

The 5V supply for this board comes from on-board regulator VR1. This regulator helps isolate both the 50 kHz switching signals from the power supply and the digital and microprocessor noise on the normal 5V supply. The raw supply for VR1 comes from the +9VLP unregulated supply on the A25 Switching Power Supply PCB.

6G-5 A10 REFERENCE BUFFER PCB, DETAILED CIRCUIT DESCRIPTION

Refer to the A10 schematic diagram in Figure 6G-7 for the following discussion.

6G-5.1 Input

The 10 MHz input at J4 comes from the A7 Reference Divider PCB. Q1 buffers it and then applies it to the four output buffer amplifiers. The buffer amplifiers going to J1, J2, and J3 are identical. The buffer amplifier for the J5 rear panel output provides additional isolation and protection from any signal applied to the J5 output.

This high isolation prevents destination circuit signals from going to the other circuits. For example, any 200 to 321 MHz signal that comes from the A11 Fine Loop Divider PCB and goes back into J1 will be attenuated by 40 dB at the J2 and J3 outputs. This prevents interaction of circuits requiring the 10 MHz reference and reduces the possibilities of spurious responses.

6G-5.2 Buffer Amplifiers

Q1 is configured as an emitter follower and receives its bias from R3 and R4. This bias sets the collector current at approximately 5 ma. R7, R8, R9, and R10 split the signal from Q1 into four paths.

Q2 is also configured as an emitter follower and receives its bias from the emitter of Q1. Its collector current is approximately 3 ma. The signal, which is ac coupled to Q6, receives its bias from R14 and R15, and has a collector current of approximately 13 ma. The signal is amplified approximately three times to overcome the losses from the splitter and emitter followers. Then, after being ac coupled, it goes to the J1 output. The peak amplitude of the J1, J2, and J3 outputs is approximately 0.2V. The other two buffer amplifiers (consisting of Q3, Q4, Q7, and Q8) operate the same as the first buffer amplifier.

Q5, an emitter follower, has a collector current of approximately 3 ma. It applies its signal to a voltage divider consisting of L3, Q9, R38, Q11, and L4. The divider, which has a current of approximately 2 ma, sets the collector current for Q10 and Q12 at approximately 10 ma. Q9 and Q11, configured as diodes, provide temperature compensation for Q10 and Q12. CR1 and CR2 prevent Q10 and Q12 from becoming saturated. CR3 and CR4 prevent damage to Q10 and Q12 by clamping any signal inadvertently applied to the J5 output. R39 provides the 50 ohm source impedance for the J5 output and current limits any signal applied to J5.

VR1, a 3-terminal on-board regulator, provides the 5V supply. It receives its voltage from the A25 Switching Power Supply +9VLP raw supply.

6G-6 REFERENCE LOOP ASSEMBLIES, TROUBLESHOOTING

Troubleshooting procedures in Table 6G-2 cover the A5 Reference Oscillator PCB, the A7 Reference Divider PCB, and the A10 Reference Buffer PCB.

6G-7 REFERENCE LOOP ASSEMBLIES, SERVICE SHEETS

Table 6G-1 on the first page of this section presents the arrangements of the block diagrams, schematics, and parts locater diagrams for the A5, A7 and A10 PCBs.

Table 6G-2. Reference Loop Troubleshooting (1 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A5 Reference Oscillator PCB Troubleshooting
	NOTE It is recommended that the A5 Reference Oscillator PCB be returned to Wiltron on an exchange basis. The alignment of the coupling loops or the movement of the capacitors in the phase-shift network for the SAW oscillator can significantly affect the operation of this circuit. The troubleshooting notes below provide information on some minor repairs that can usually be made without affecting operation of the SAW oscillator. These should only be attempted in emergency situations.
Low Output Level(s)	A low output usually results from one of the buffer amplifiers. A defective buffer amplifier can also affect the output of the other amplifiers. The best way to determine which amplifier is defective is to measure the dc collector voltages. Q3 can also affect all the output levels. Extra care must be used when replacing this transistor because the coupling loop is in its base leg. These transistors have a small insulating washer beneath them. It is important to leave this washer between the transistor and the PCB. Also, the transistors must press against the insulator and PCB to minimize the lead length. Not doing this can severely degrade the assembly's performance. If U1 is defective, the output is usually against the supply rail. However, if the phase detector is defective, it can also cause the U1 output to go to the supply rail. Open the input to U1 and apply a negative external voltage source to tune the oscillator. Connecting test points 1 and 2 with a jumper fixes the gain of U1. By adjusting the external voltage source, the output of U1 appears along with the frequency of the SAW oscillator. The SAW oscillator has a tuning range of approximately –20 kHz to +50 kHz, centered at 500 MHz. The best way to see this is either with a synthesized spectrum analyzer, such as the TEK 494 or HP 8566, or a frequency counter. For best overall accuracy, set the synthesizer or counter for an external reference and connect the 10 MHz REF OUTPUT on the rear panel to the external reference input of the spectrum analyzer or counter. The output power of the A5 board outputs is measured with the other outputs terminated in 50 ohms. The measurements are as follows: • J1: 0 dBm +1 dB/–1 dB • J2: +7 dBm +0 dB/–1 dB • J3: –3 dBm +/–.2 dB (Adjust R37.) If the output from J3 is too low or too high, it can cause spurious signals in the 0.01-2 GHz frequency range. For adjustment of C9, follow the procedure under the E5-13 error code. Shorting the +15V supplies to ground on the A5 PCB usually damages Q6 and Q7. Check this by noting the emitter-base and collector-emitter voltage drops. • The emitter-base voltage drop should be approximately 0.5 to 0.7 Vdc. The collector-emitter voltage drop should be approximately 0.2 to 0.4 Vdc. **NOTE** Keep J1 connected to maintain 500 MHz.

Table 6G-2. Reference Loop Troubleshooting (2 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A5 Reference Oscillator PCB Troubleshooting (Continued)
E5-10	The self test was not able to determine the failure mode by using the E5-11 through E5-13 code tests. This indicates a failure in either the A5 or A7 PCB, or in the 10 MHz crystal oscillator circuit. To troubleshoot: • Press SHIFT, RESET. • Press SHIFT, TRIGGER, then enter 0 1 0 from the keypad. The FREQUENCY display indicates 500 MHz and the LEVEL displays a voltage from –0.3V to +7.5V. • Connect a frequency counter to A5J3. • Connect a power meter to A5J1. If the LEVEL display indicates approximately +7.5V: • The frequency counter should indicate 500.050 MHz ±4 kHz. • The power meter should indicate 0 dBm ±1 dB. If the LEVEL display indicates approximately –0.3V: • The counter should indicate 499.980 MHz ±4 kHz. • The power meter should indicate 0 dBm ±1 dB. If the power meter indication is low or 0 dBm, the problem is in the A5Q4 circuit. If the counter does not count and the power meter is low or 0 dBm, the problem is either with the A5Q2 or A5Q3 circuit. If power meter indication is correct, move the power meter to A5J2 and terminate A5J1 into 50Ω. The power meter should indicate +7 +0dB/–1 dB. If the power meter indication is low or 0 dB, the problem is in the A5Q2 circuit. See the A5 PCB troubleshooting hints on the previous page. Connect the power meter to A5J3. It should read –3 dBm ±0.2 dB. If not, adjust A5R37. If the A5 PCB meets the above specifications, but the unit will still not lock, refer to error codes E5-11 and E5-12 for troubleshooting.
E5-11	Connect an external 10 MHz reference (10 MHz ±100 Hz) to the 67XXA rear panel 10 MHz REF INPUT connector. Press SELF TEST. • If error code E5-11 is no longer displayed, the problem is the 10 MHz internal reference oscillator or the A7Q8 circuit. • If error code E5-11 is still present, the problem is in the A7U5, A7U6, or A5U7 circuit. See the A7 PCB troubleshooting hints.
E5-12	Connect a spectrum analyzer to A5J1. The spectrum analyzer should display a signal at 500.050 MHz at approximately 0 dBm. • If the signal is present, the problem is in the A7Q1, A7U1, A7U4, A7U6 or A7U7 circuit. • If the 500.050 MHz signal is not observed on the spectrum analyzer, refer to error code E5-10 for troubleshooting. • •

Table 6G-2. Reference Loop Troubleshooting (3 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A5 Reference Oscillator PCB Troubleshooting (Continued)
E5-13	The following calibration of the Reference Oscillator frequency should be done only when the E5-13 error code is displayed. It should *not* be performed as a routine calibration. • Install the A5 PCB on an extender board. • Connect a frequency counter to A5J3. • Remove the connection between A5J1 and A7J1. • Adjust C9 for 500.050 MHz. • Press <Shift> TRIGGER, and enter 0 1 0 from the keypad. • Reconnect A5J1 to A7J1. • The level display should indicate approximately +3V. • Note and record the reading. • Remove the A5 PCB from the extender, and reinstall it in the synthesizer. • Note the LEVEL display indication. • Subtract this reading from the reading previously noted. • Install A5 on the extender board again. Adjust C9 until the LEVEL display indicates the first recorded reading plus the difference between the first and second reading ±0.02V. *Example:* Assume the first reading is 3.00V and that the second reading is 3.10V. You would adjust C9 for 2.90V ±0.02V [3.00 – 3.10 = –0.1;3.00 + (–0.1) = 2.90V ±0.02V]. Install the A5 PCB in the RF casting without the extender. The level display should remain at the first recorded indication ±0.05V.

Table 6G-2. Reference Loop Troubleshooting (4 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A7 Reference Divider PCB Troubleshooting
	When the A7 board operates normally, loss of the 500 MHz input at J1 causes the voltage at P1-6 to go to approximately −12V and loss of the 10 MHz reference at J5 causes this voltage to go to +12V. To check the 500 MHz path, apply a 500 MHz, 0 dBm signal from an external synthesizer to A5J1. Measure a 10 MHz signal of approximately 2 Vp-p at J3. Measure A5TP1 if you don't get this signal. You should get a 50 MHz TTL signal. If this signal is not there, either Q1 or U1 is defective. If this signal appears, measure A5TP2. If no signal appears, U2, U3, or U4 is defective. If there is a signal at TP2, but none at J3, then the Q3 circuit is defective. The 10 MHz path is relatively easy to trace with a normal oscilloscope. There should be a 10 MHz signal at A5TP3. Trace this signal back from there. With 10 MHz applied from an external source, the internal crystal oscillator should turn off and you can trace the signal back to J4. To use the internal crystal oscillator in place of an external 10 MHz source, lift one end of R26. This will keep the external 10 MHz circuitry from turning the internal oscillator off. With the 10 MHz operating, you can adjust the 500 MHz signal slightly above and below 500 MHz and observe U7-6. This voltage should go from approximately +12V for a high frequency, to −12V for a low frequency. This indicates that the phase detector circuits are operating. Use a 50 MHz (or greater) scope to observe the outputs of U6 and see the pulses. A sweep is usually not stable enough for this purpose. There is too much residual FM and you cannot get a stable pulse. When the synthesizer and another synthesizer use the same time base, a stable signal can be obtained at the U6 output by adjusting the 500 MHz to where its divided 10 MHz signal is exactly the same as the time base. However, the phase offset will always give a dc output voltage from U7, and the pulses from U6 will have unequal widths. Some synthesizers have an adjustable variable phase. This allows the U6 and U7 outputs to be observed by adjusting the phase of the external synthesizer. An external synthesizer can also work with the External 10 MHz reference. Do not try to measure phase noise under these conditions, however, unless the phase noise of the external synthesizer is equal to or better than the internal 10 MHz crystal.
	A10 Reference Buffer PCB Troubleshooting
	This board is very easy to troubleshoot with an oscilloscope and digital voltmeter. Apply a 10 MHz, −2 dBm signal to J4 and measure the outputs with an oscilloscope or power meter. Then measure the dc voltages shown on the schematic to localize the defective component.

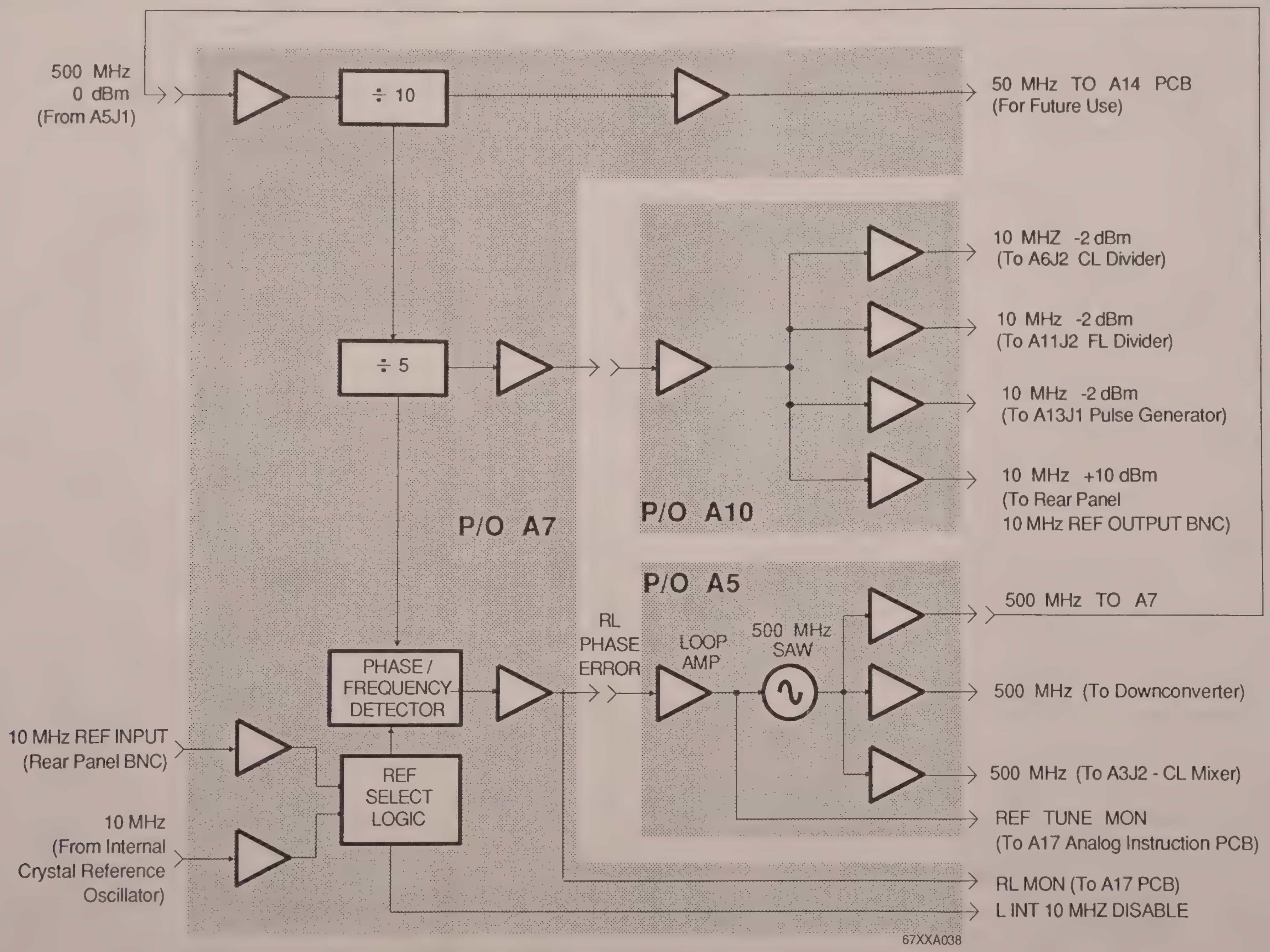

500 MHz
0 dBm
(From A5J1)
÷ 10
50 MHz TO A14 PCB
(For Future Use)
10 MHZ -2 dBm
(To A6J2 CL Divider)
÷ 5
10 MHz -2 dBm
(To A11J2 FL Divider)
10 MHz -2 dBm
(To A13J1 Pulse Generator)
10 MHz +10 dBm
(To Rear Panel
10 MHz REF OUTPUT BNC)
P/O A7
P/O A10
P/O A5
500 MHz TO A7
RL
PHASE
ERROR
LOOP
AMP
500 MHz
SAW
PHASE /
FREQUENCY
DETECTOR
500 MHz (To Downconverter)
10 MHz REF INPUT
(Rear Panel BNC)
REF
SELECT
LOGIC
500 MHz (To A3J2 - CL Mixer)
10 MHz
(From Internal
Crystal Reference
Oscillator)
REF TUNE MON
(To A17 Analog Instruction PCB)
RL MON (To A17 PCB)
L INT 10 MHZ DISABLE
67XXA038

Figure 6G-1.
Reference Loop Block Diagram

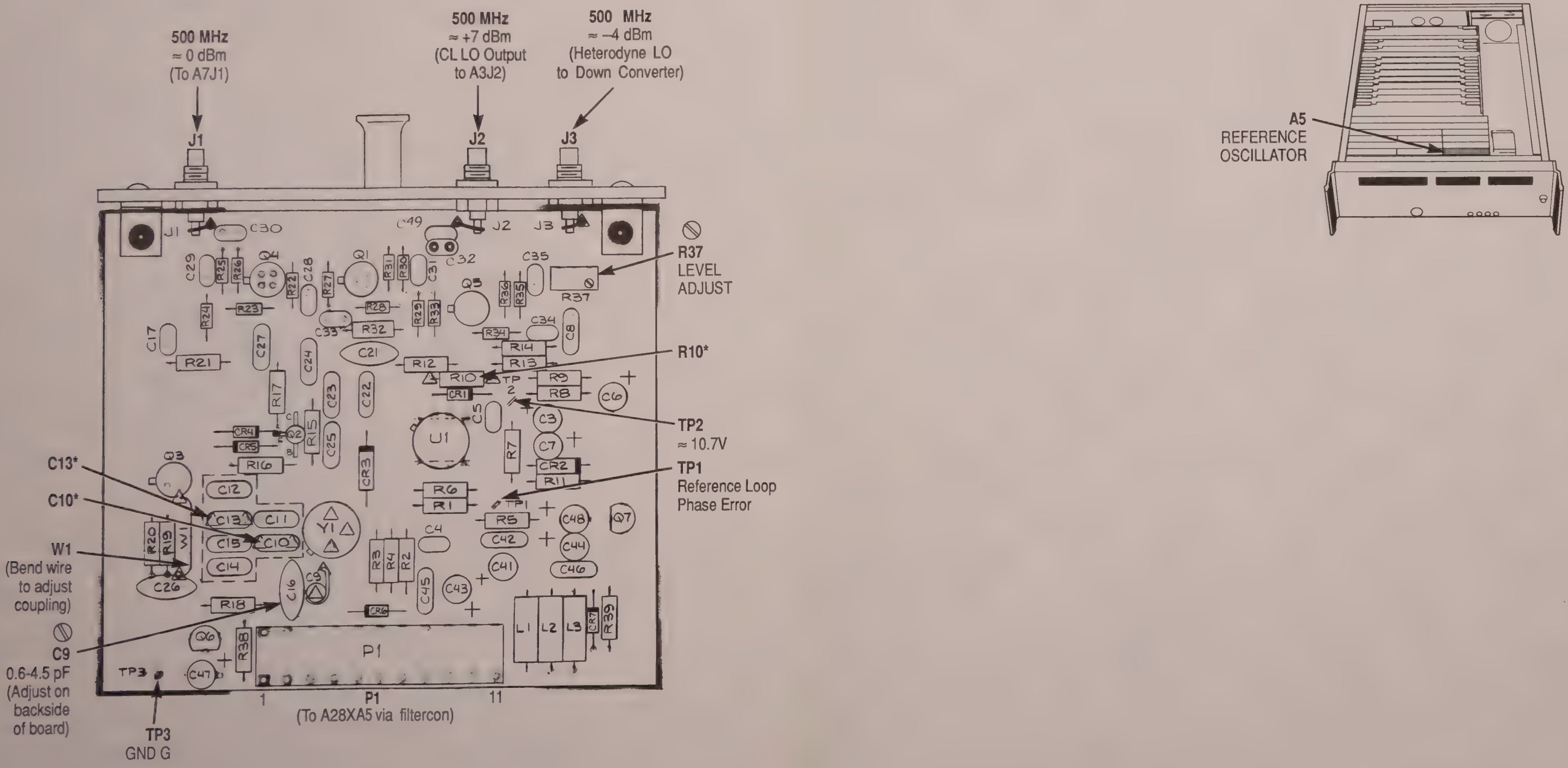
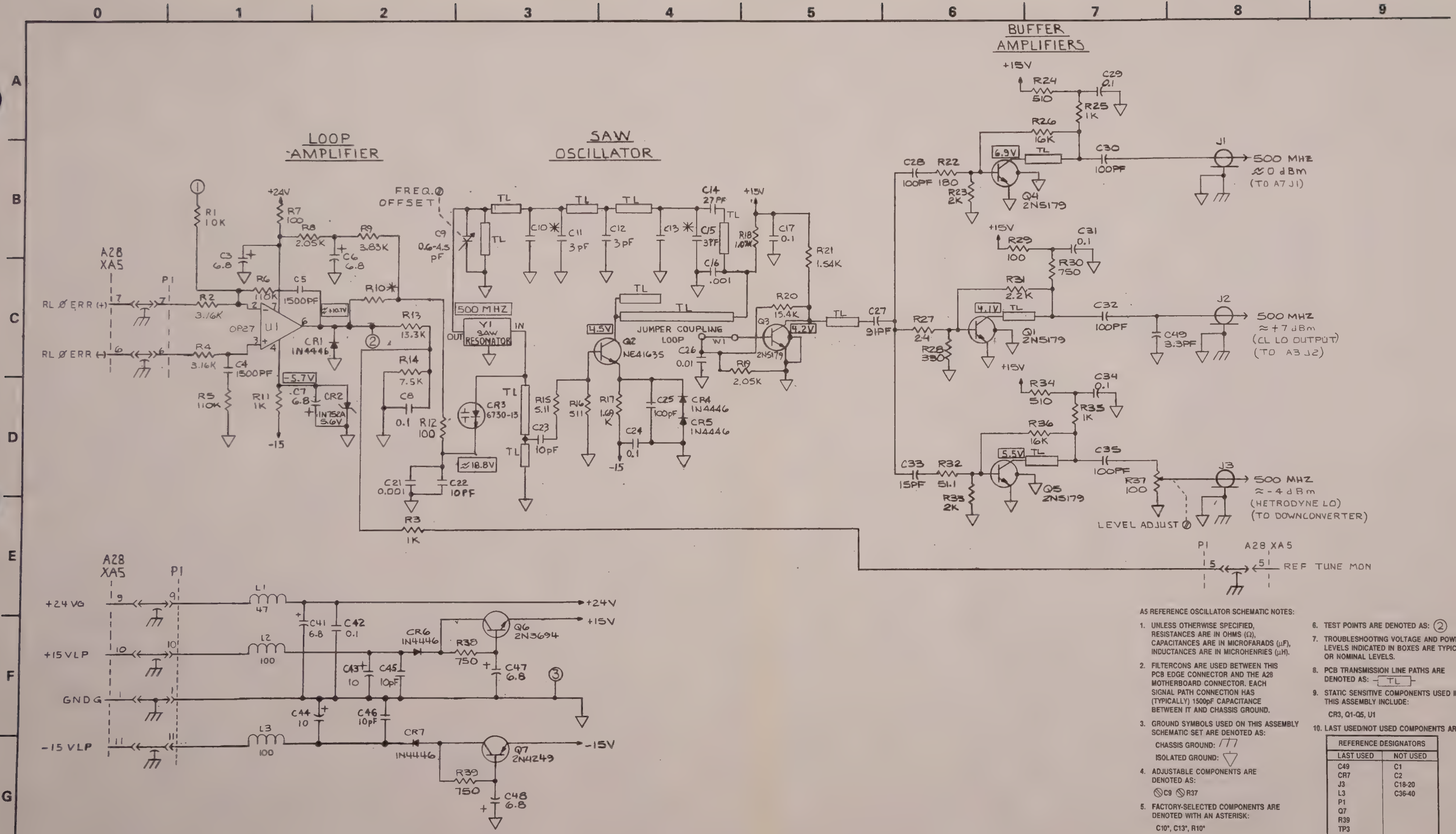

500 MHz
≈ 0 dBm
(To A7J1)
J1
500 MHz
≈ +7 dBm
(CL LO Output
to A3J2)
J2
500 MHz
≈ –4 dBm
(Heterodyne LO
to Down Converter)
J3
R37
LEVEL
ADJUST
R10*
TP2
≈ 10.7V
TP1
Reference Loop
Phase Error
C13*
C10*
W1
(Bend wire
to adjust
coupling)
C9
0.6-4.5 pF
(Adjust on
backside
of board)
TP3
GND G
1
P1
11
(To A28XA5 via filtercon)
A5
REFERENCE
OSCILLATOR

Figure 6G-2. A5 Reference Oscillator PCB Parts Locater Diagram
6700-D-31705-3 (Rev. F)


BUFFER AMPLIFIERS
LOOP AMPLIFIER
SAW OSCILLATOR
A28 XA5
P1
RL Ø ERR (+)
RL Ø ERR (-)
U1 OP27
R1 10K
R2 3.16K
R4 3.16K
R5 110K
R6 110K
R7 100
R8 2.05K
R9 3.83K
R10*
R11 1K
R12 100
R13 13.3K
R14 7.5K
R3 1K
C3 6.8
C4 1500PF
C5 1500PF
C6 6.8
C7 6.8
C8 0.1
C21 0.001
C22 10PF
CR1 1N4446
CR2 1N752A 5.6V
-5.7V
≈10.7V
≈18.8V
+24V
-15
FREQ. OFFSET
C9 0.6-4.5 pF
500 MHZ
Y1 SAW RESONATOR
IN
OUT
TL
C10*
C11 3pF
C12 3pF
C13*
C14 27PF
C15 3PF
C16 .001
C17 0.1
R18 1.07M
R21 1.54K
CR3 6730-13
R15 5.11
R16 511
R17 1.69K
C23 10pF
C24 0.1
C25 100pF
CR4 1N4446
CR5 1N4446
4.5V
Q2 NE41635
JUMPER COUPLING LOOP
W1
C26 0.01
R19 2.05K
R20 15.4K
Q3 2N5179
4.2V
+15V
C27 91PF
R27 24
R28 330
Q1 2N5179
4.1V
R29 100
R30 750
R31 2.2K
C31 0.1
C32 100PF
C49 3.3PF
J2
500 MHZ ≈ +7 dBm (CL LO OUTPUT) (TO A3 J2)
R24 510
R25 1K
R26 16K
C29 0.1
C28 100PF
R22 180
R23 2K
Q4 2N5179
6.9V
C30 100PF
J1
500 MHZ ≈ 0 dBm (TO A7 J1)
R34 510
R35 1K
R36 16K
C34 0.1
C33 15PF
R32 51.1
R33 2K
Q5 2N5179
5.5V
C35 100PF
R37 100
LEVEL ADJUST
J3
500 MHZ ≈ -4 dBm (HETRODYNE LO) (TO DOWNCONVERTER)
REF TUNE MON
+24 VG
+15 VLP
GNDG
-15 VLP
L1 47
L2 100
L3 100
C41 6.8
C42 0.1
C43 10
C44 10
C45 10pF
C46 10pF
CR6 1N4446
CR7 1N4446
Q6 2N3694
Q7 2N4249
R38 750
R39 750
C47 6.8
C48 6.8
+24V
+15V
-15V
①
②
③

A5 REFERENCE OSCILLATOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   CHASSIS GROUND: ⏚

   ISOLATED GROUND: ▽
4. ADJUSTABLE COMPONENTS ARE DENOTED AS:

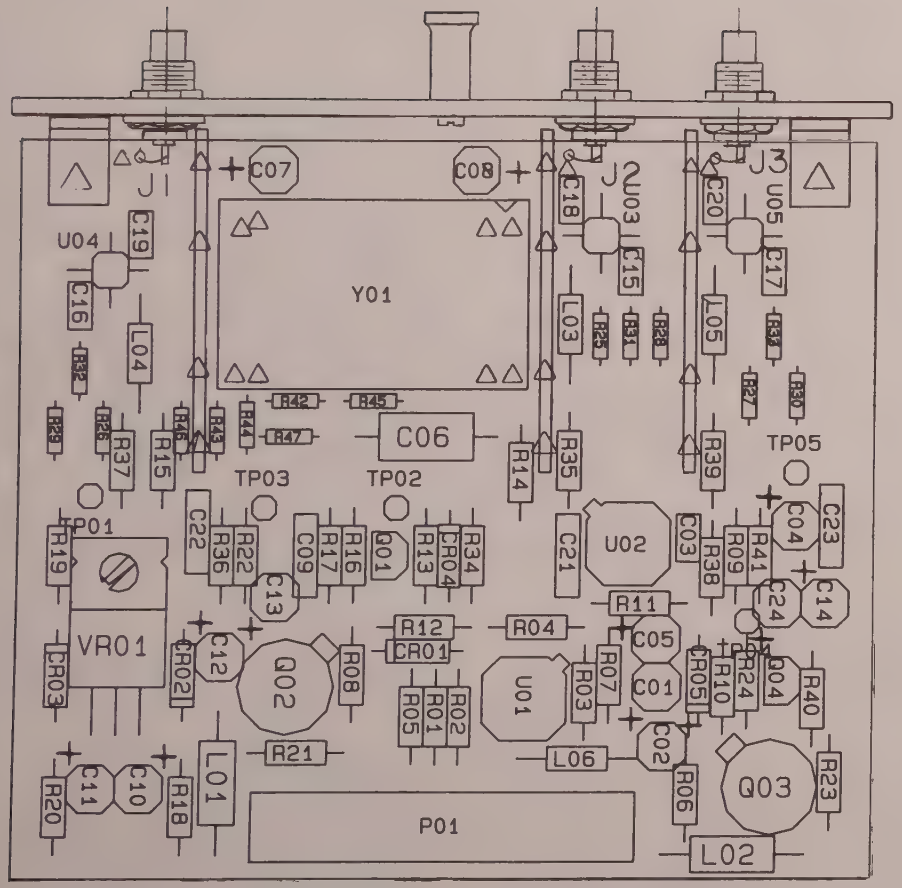
   ⃠C9 ⃠R37
5. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK:

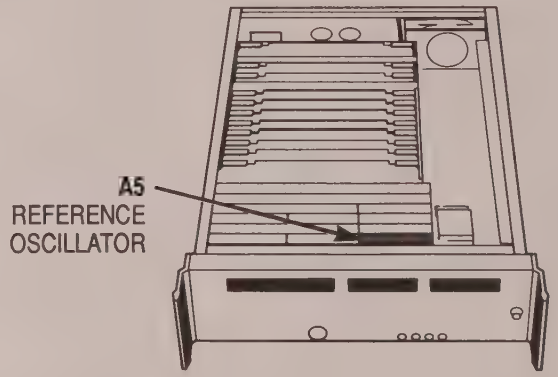
   C10*, C13*, R10*
6. TEST POINTS ARE DENOTED AS: ②
7. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
8. PCB TRANSMISSION LINE PATHS ARE DENOTED AS: -[TL]-
9. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   CR3, Q1-Q5, U1
10. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C49 CR7 J3 L3 P1 Q7 R39 TP3 W1 Y1	C1 C2 C18-20 C36-40

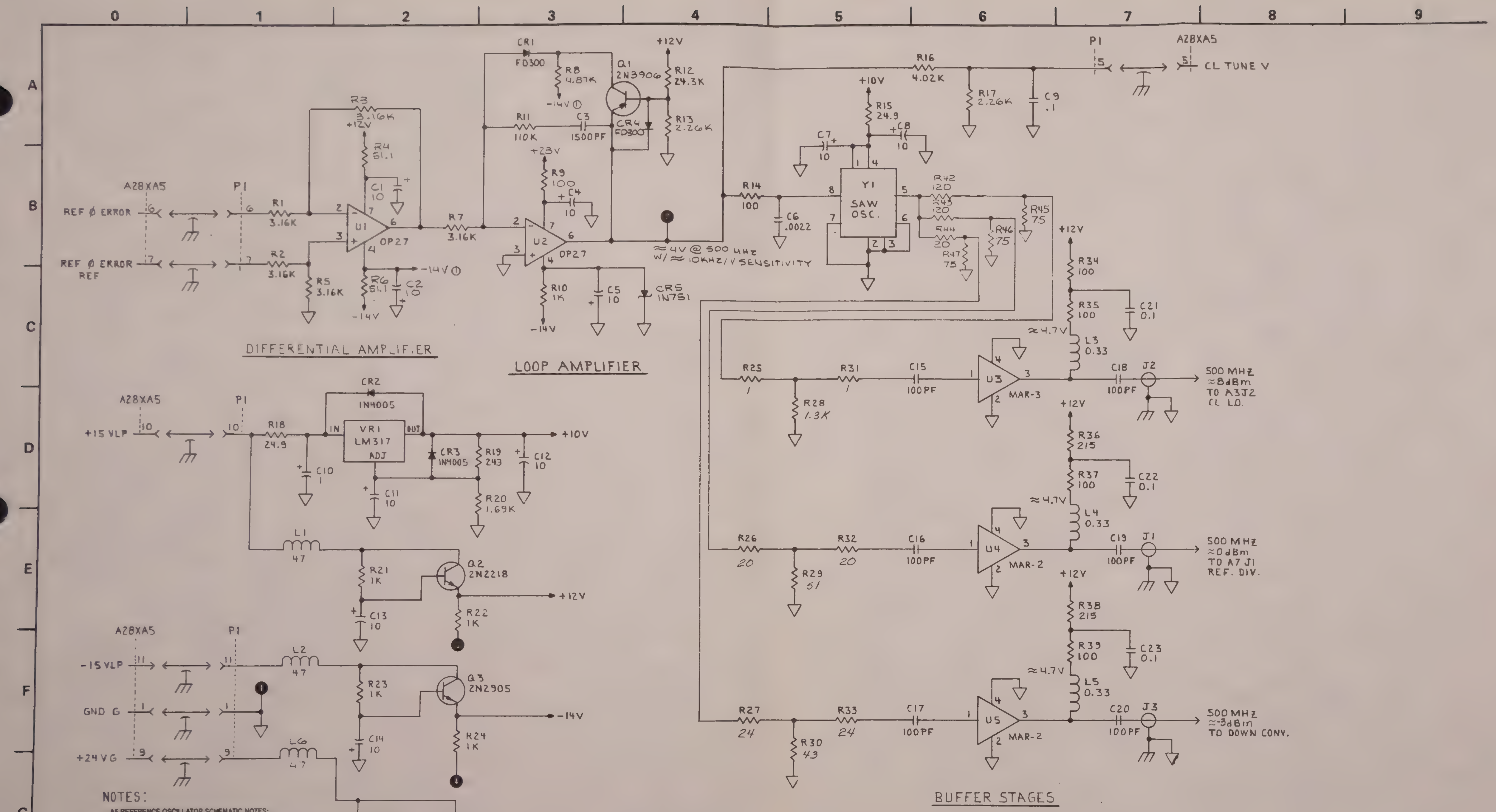
Figure 6G-3. A5 Reference Oscillator PCB Schematic Diagram (Sheet 1 of 1)
6700-D-31705-3 (Rev. F)


J1
C07
C08
J2
J3
U03
U05
C18
C20
U04
C19
Y01
C15
C17
C16
L04
L03
L05
R25
R31
R28
R33
R32
R27
R30
R29
R26
R37
R15
R46
R43
R44
R42
R45
R47
C06
R14
R35
R39
TP05
TP03
TP02
TP01
C22
R36
R22
C09
R17
R16
Q01
R13
CR04
R34
C21
U02
C03
R38
R09
R41
C04
C23
R19
C13
C24
C14
R11
R12
R04
C05
VR01
CR02
C12
Q02
CR01
R08
R05
R01
R02
U01
R03
R07
C01
CR05
R10
R24
Q04
R40
CR03
R21
L06
C02
R20
C11
C10
R18
L01
R06
Q03
R23
P01
L02


A5
REFERENCE
OSCILLATOR

NOTE:
This is a newer version of the A5 Reference Oscillator PCB that is provided on later models. The older version is shown in Figures 6G-2 and 6G-3.

Figure 6G-4. A5 Reference Oscillator PCB Parts Locator Diagram (New Version) 6700-D-31805-3 (Rev. C)


0 1 2 3 4 5 6 7 8 9
A B C D E F G H
DIFFERENTIAL AMPLIFIER
LOOP AMPLIFIER
BUFFER STAGES
A28XA5
P1
REF Ø ERROR
REF Ø ERROR REF
R1 3.16K
R2 3.16K
R3 3.16K
R4 51.1
R5 3.16K
R6 51.1
C1 10
C2 10
U1 OP27
+12V
-14V ①
R7 3.16K
CR1 FD300
R8 4.87K
Q1 2N3906
R12 24.3K
R13 2.26K
CR4 FD300
R11 110K
C3 1500PF
+23V
R9 100
C4 10
U2 OP27
R10 1K
C5 10
CR5 1N751
≈4V @ 500 MHz W/ ≈ 10KHZ/V SENSITIVITY
R16 4.02K
R17 2.26K
C9 .1
CL TUNE V
+10V
R15 24.9
C7 10
C8 10
R14 100
C6 .0022
Y1 SAW OSC.
R42 120
R43 120
R44 20
R45 75
R46 75
R47 75
R34 100
R35 100
C21 0.1
L3 0.33
≈4.7V
R25
R31
C15 100PF
R28 1.3K
U3 MAR-3
C18 100PF
J2
500 MHz ≈8dBm TO A3J2 CL LO.
R36 215
R37 100
C22 0.1
L4 0.33
R26 20
R32 20
C16 100PF
R29 51
U4 MAR-2
C19 100PF
J1
500 MHz ≈0dBm TO A7 J1 REF. DIV.
R38 215
R39 100
C23 0.1
L5 0.33
R27 24
R33 24
C17 100PF
R30 43
U5 MAR-2
C20 100PF
J3
500 MHz ≈-3dBm TO DOWN CONV.
+15 VLP
R18 24.9
CR2 1N4005
VR1 LM317 IN OUT ADJ
CR3 1N4005
R19 243
R20 1.69K
C10 1
C11 10
C12 10
L1 47
R21 1K
Q2 2N2218
C13 10
R22 1K
-15 VLP
L2 47
R23 1K
Q3 2N2905
C14 10
R24 1K
-14V
GND G
+24 VG
L6 47
R40 1K
Q4 2N2222A
C24 10
R41 1K
+23V

NOTES:

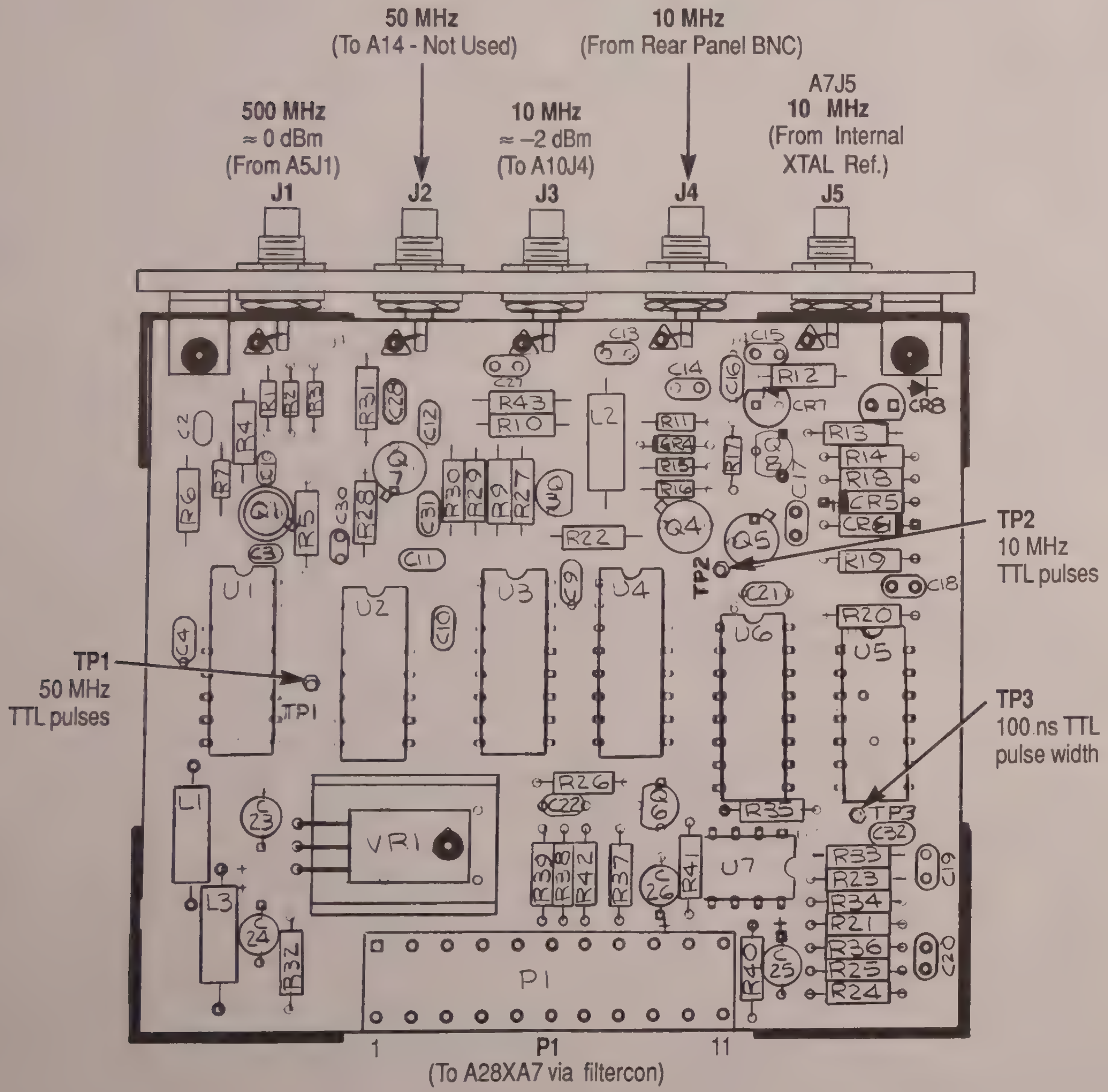
A5 REFERENCE OSCILLATOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏚
   ISOLATED GROUND: ▽
4. TEST POINTS ARE DENOTED AS: ⑮
5. ★ DENOTES FACTORY SELECT.

LAST USED	NOT USED
R47	
C24	
U5	
VR1	
Q4	
TP5	
F1	
Y1	
L6	
CR5	

NOTE:
This is a newer version of the A5 Reference Oscillator PCB that is provided on later models. The older version is shown in Figures 6G-2 and 6G-3.

Figure 6G-3. A5 Reference Oscillator PCB (New Version)
Schematic Diagram (Sheet 1 of 1)
6700-D-31805-3 (Rev. C)


50 MHz
(To A14 - Not Used)
10 MHz
(From Rear Panel BNC)
500 MHz
≈ 0 dBm
(From A5J1)
J1
J2
10 MHz
≈ −2 dBm
(To A10J4)
J3
J4
A7J5
10 MHz
(From Internal
XTAL Ref.)
J5
TP1
50 MHz
TTL pulses
TP2
10 MHz
TTL pulses
TP3
100 ns TTL
pulse width
U1
U2
U3
U4
U5
U6
U7
VR1
L1
L2
L3
Q1
Q2
Q3
Q4
Q5
CR5
CR6
CR7
CR8
P1
1
11
P1
(To A28XA7 via filtercon)

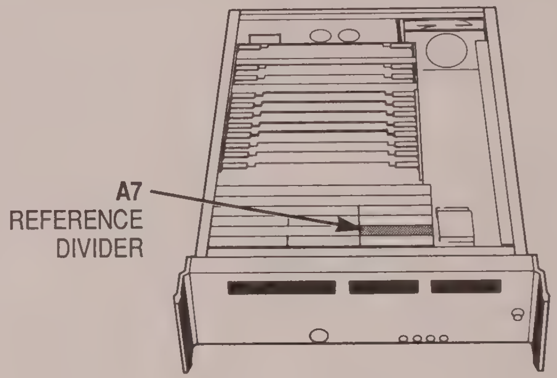
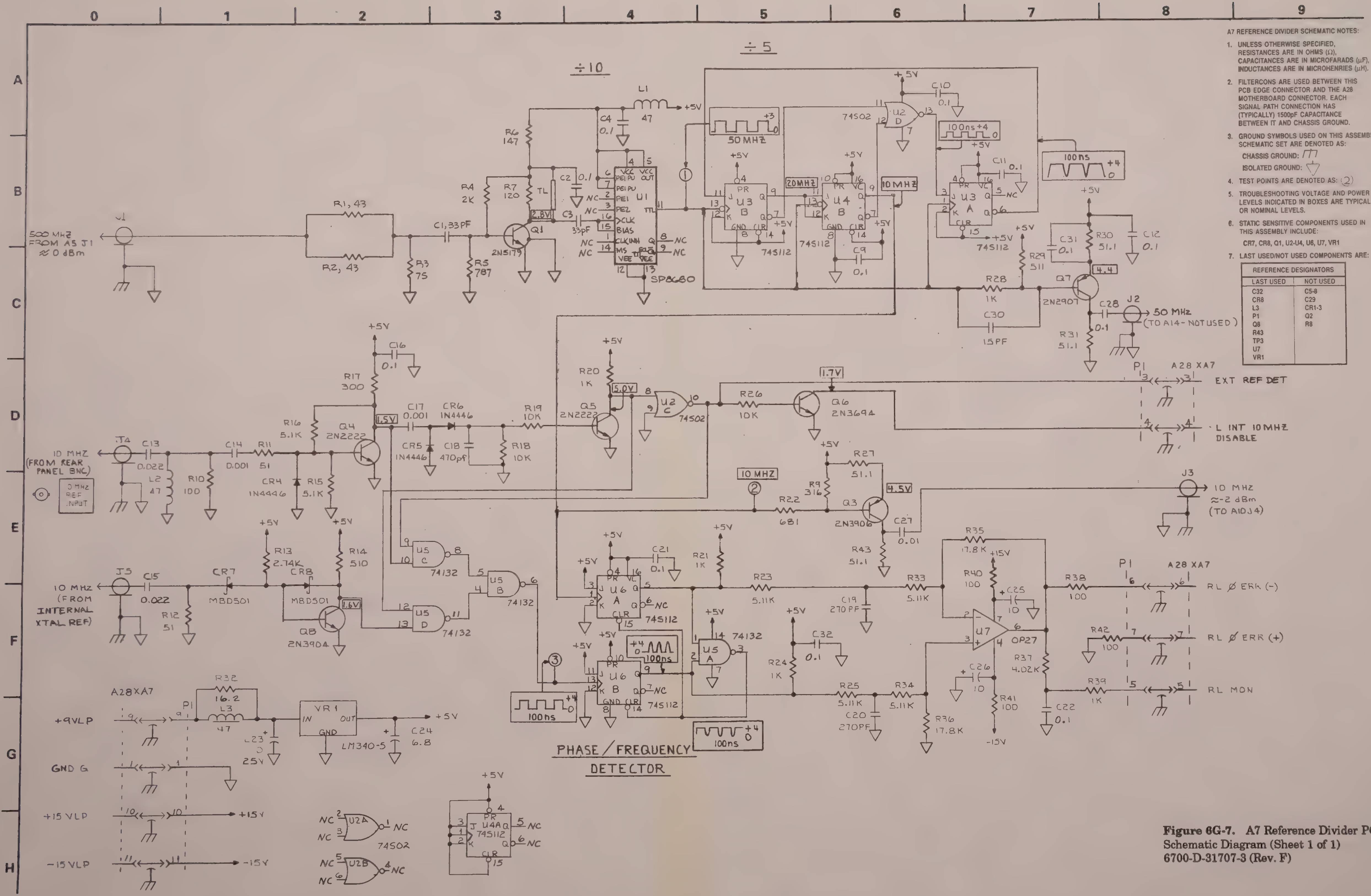

A7
REFERENCE
DIVIDER

Figure 6G-6. A7 Reference Divider PCB Parts Locator Diagram
6700-D-31707-3 (Rev. E)

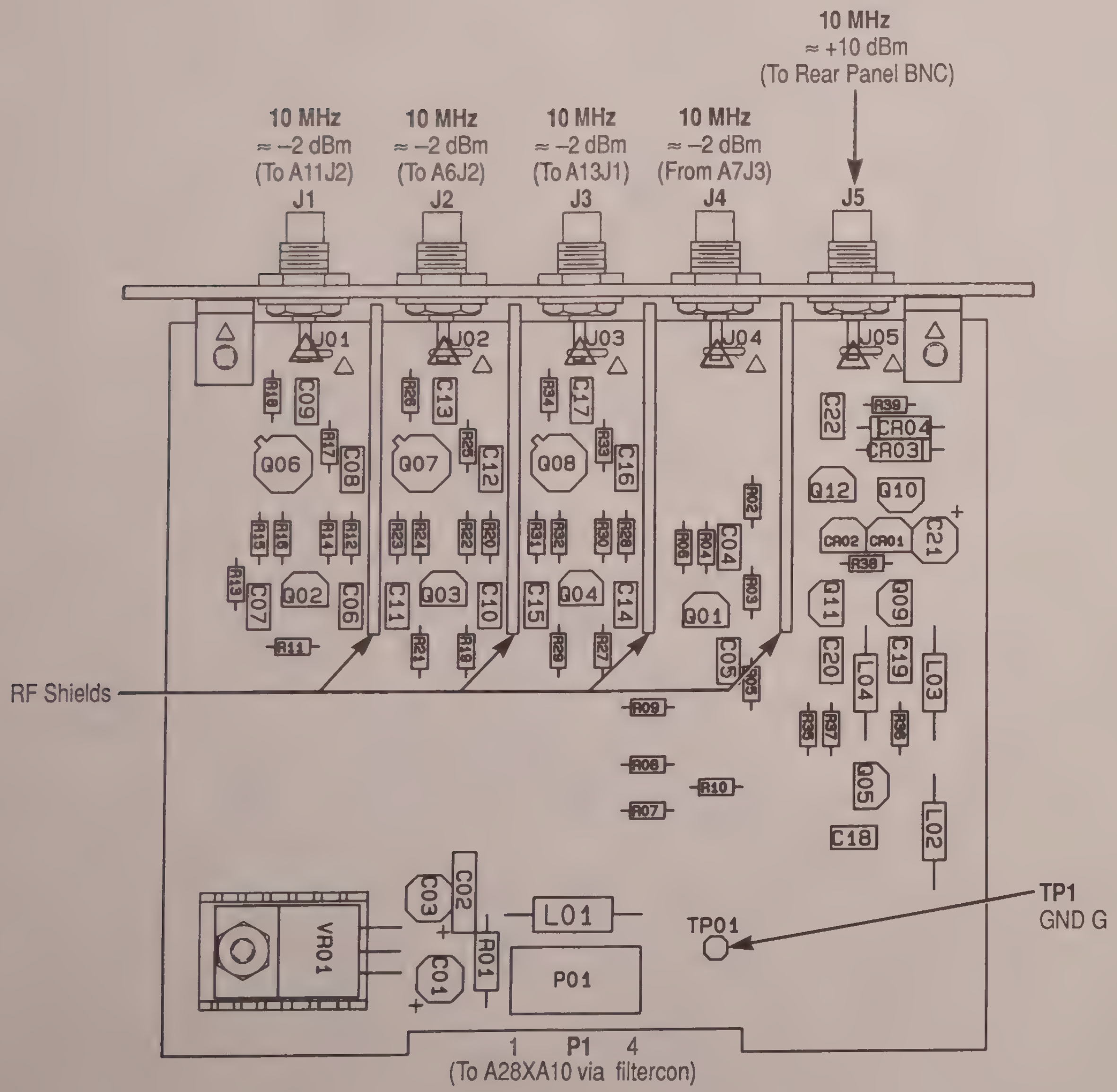

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
÷10
÷5
500 MHz FROM A5 J1 ≈ 0 dBm
J1
R1, 43
R2, 43
C1, 33PF
R3 75
R5 787
R4 2K
R6 147
R7 120
TL
2.8V
Q1 2N5179
C2 0.1
C3 33pF
C4 0.1
L1 47
+5V
U1 SP8680
VCC PE1 PU
VCC OUT
PE1 PU
PE1
PE2
CLK
BIAS
CLKINH
MS
VEE
TTL
NC
50 MHZ
20MHZ
10MHZ
100ns
74S112
74S02
U2 D
U3 B
U4 B
U3 A
C9 0.1
C10 0.1
C11 0.1
C12 0.1
C31 0.1
R30 51.1
R29 511
R28 1K
C30 15PF
Q7 2N2907
4.4
C28 0.1
J2
50 MHz (TO A14 - NOT USED)
R31 51.1
P1
A28 XA7
EXT REF DET
L INT 10MHZ DISABLE
10 MHZ (FROM REAR PANEL BNC)
10 MHz REF INPUT
J4
C13 0.022
L2 47
R10 100
C14 0.001
R11 51
CR4 1N4446
R15 5.1K
R16 5.1K
R17 300
C16 0.1
Q4 2N2222
1.5V
C17 0.001
CR6 1N4446
CR5 1N4446
C18 470pF
R18 10K
R19 10K
R20 1K
5.0V
Q5 2N2222
U2 C 74S02
R26 10K
1.7V
Q6 2N3694
10 MHZ
R22 681
R9 316
R27 51.1
Q3 2N3906
4.5V
C27 0.01
R43 51.1
J3
10 MHZ ≈-2 dBm (TO A10J4)
10 MHZ (FROM INTERNAL XTAL REF)
J5
C15 0.022
R12 51
CR7 MBD501
CR8 MBD501
R13 2.74K
R14 510
Q8 2N3904
1.6V
U5 C 74132
U5 B 74132
U5 D 74132
U5 A 74132
U6 A 74S112
U6 B 74S112
C21 0.1
R21 1K
R23 5.11K
C19 270 PF
R33 5.11K
R35 17.8K
R40 100
C25 10
U7 OP27
+15V
-15V
C26 10
R41 100
R37 4.02K
C22 0.1
R38 100
R42 100
R39 1K
RL Ø ERR (-)
RL Ø ERR (+)
RL MON
R24 1K
C32 0.1
R25 5.11K
C20 270PF
R34 5.11K
R36 17.8K
PHASE / FREQUENCY DETECTOR
A28XA7
+9VLP
GND G
+15 VLP
-15 VLP
R32 16.2
L3 47
VR1 LM340-5
IN OUT GND
C23 25V
C24 6.8
+15V
-15V
U2A 74S02
U2B
U4A 74S112
NC

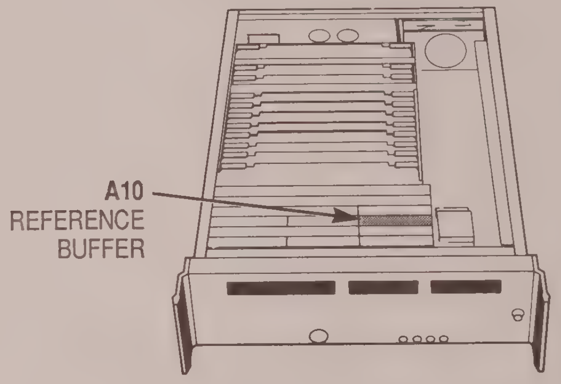
A7 REFERENCE DIVIDER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏚
   ISOLATED GROUND: ▽
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR7, CR8, Q1, U2-U4, U6, U7, VR1
7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C32	C5-8
CR8	C29
L3	CR1-3
P1	Q2
Q8	R8
R43	
TP3	
U7	
VR1	

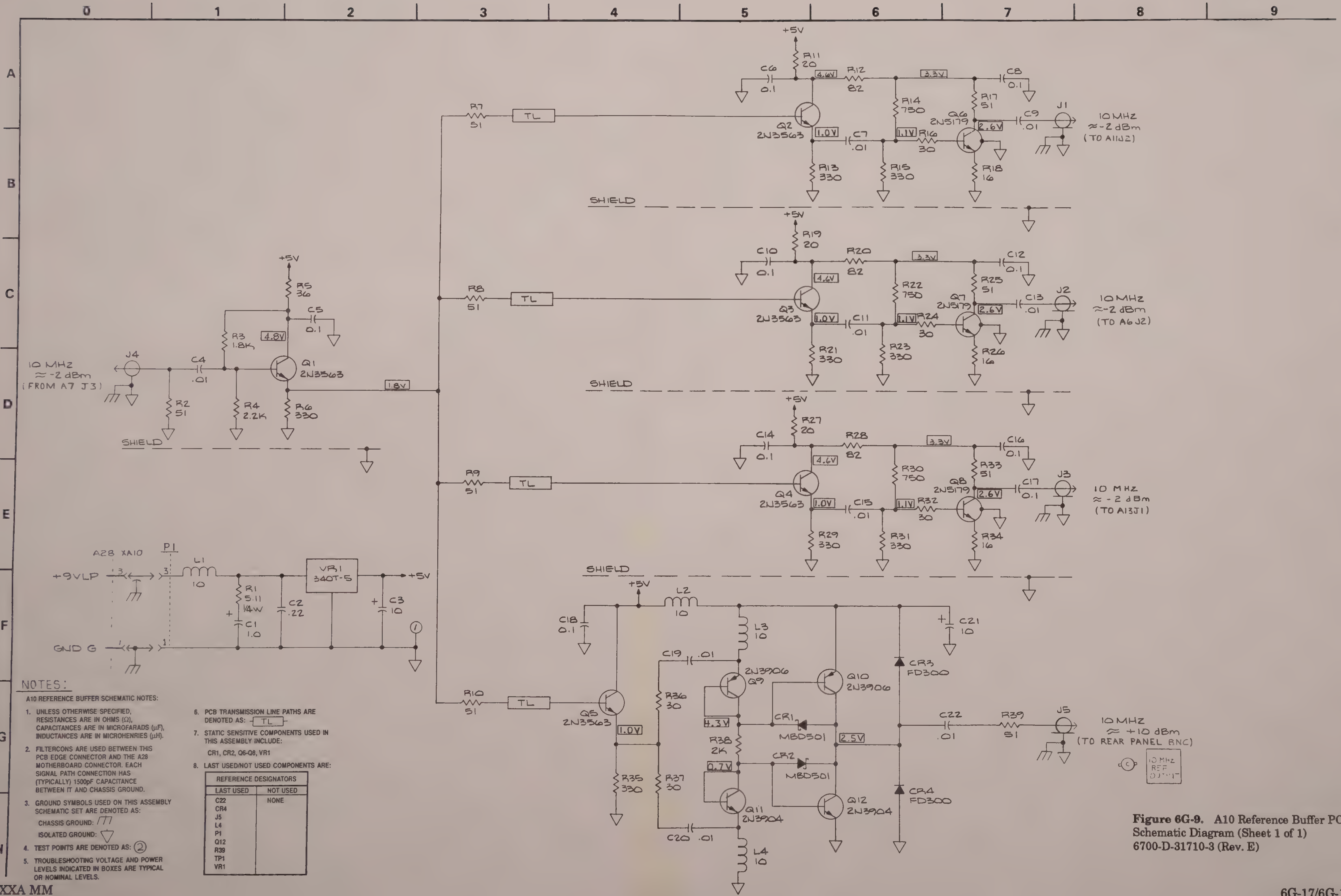
Figure 6G-7. A7 Reference Divider PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31707-3 (Rev. F)


10 MHz
≈ –2 dBm
(To A11J2)
J1
10 MHz
≈ –2 dBm
(To A6J2)
J2
10 MHz
≈ –2 dBm
(To A13J1)
J3
10 MHz
≈ –2 dBm
(From A7J3)
J4
10 MHz
≈ +10 dBm
(To Rear Panel BNC)
J5
J01
J02
J03
J04
J05
Q06
Q07
Q08
Q02
Q03
Q04
Q01
Q12
Q10
Q11
Q09
Q05
C09
C08
C07
C06
C13
C12
C11
C10
C17
C16
C15
C14
C04
C05
C22
C21
C20
C19
C18
CR04
CR03
CR02
CR01
L04
L03
L02
L01
VR01
C03
C02
C01
R01
P01
TP01
RF Shields
TP1
GND G
1 P1 4
(To A28XA10 via filtercon)


A10
REFERENCE
BUFFER

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6G-8. A10 Reference Buffer PCB Parts Locator Diagram
6700-D-31710-3 (Rev. D)



0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
+5V
R11 20
C6 0.1
4.6V
R12 82
3.3V
C8 0.1
R14 750
R17 51
C9 .01
J1
10 MHZ ≈-2 dBm (TO A11J2)
R7 51
TL
Q2 2N3563
1.0V
C7 .01
1.1V
R16 30
Q6 2N5179
2.6V
R13 330
R15 330
R18 16
SHIELD
+5V
R19 20
C10 0.1
R20 82
3.3V
C12 0.1
4.6V
R22 750
R25 51
C13 .01
J2
10 MHZ ≈-2 dBm (TO A6 J2)
R8 51
TL
Q3 2N3563
1.0V
C11 .01
1.1V
R24 30
Q7 2N5179
2.6V
R21 330
R23 330
R26 16
SHIELD
+5V
R27 20
C14 0.1
R28 82
3.3V
C16 0.1
4.6V
R30 750
R33 51
C17 0.1
J3
10 MHZ ≈ -2 dBm (TO A13J1)
R9 51
TL
Q4 2N3563
1.0V
C15 .01
1.1V
R32 30
Q8 2N5179
2.6V
R29 330
R31 330
R34 16
SHIELD
+5V
R5 36
C5 0.1
R3 1.8K
4.8V
J4
C4 .01
Q1 2N3563
10 MHZ ≈ -2 dBm (FROM A7 J3)
1.8V
R2 51
R4 2.2K
R6 330
SHIELD
A28 XA10
P1
+9VLP
3
3
L1 10
R1 5.11 1/4W
C1 1.0
C2 .22
VR1 340T-5
+5V
C3 10
1
GND G
1
1
SHIELD
+5V
L2 10
C18 0.1
C21 10
L3 10
C19 .01
2N3906 Q9
Q10 2N3906
CR3 FD300
R10 51
TL
Q5 2N3563
R36 30
4.3V
CR1 MBD501
2.5V
C22 .01
R39 51
J5
10 MHZ ≈ +10 dBm (TO REAR PANEL BNC)
1.0V
R38 2K
0.7V
CR2 MBD501
10 MHZ REF OUTPUT
R35 330
R37 30
CR4 FD300
Q11 2N3904
Q12 2N3904
C20 .01
L4 10

NOTES:

A10 REFERENCE BUFFER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏚
   ISOLATED GROUND: ▽
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. PCB TRANSMISSION LINE PATHS ARE DENOTED AS: -[TL]-
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR1, CR2, Q6-Q8, VR1
8. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C22 CR4 J5 L4 P1 Q12 R39 TP1 VR1	NONE

Figure 6G-9. A10 Reference Buffer PCB Schematic Diagram (Sheet 1 of 1)
6700-D-31710-3 (Rev. E)

6H – COARSE LOOP A3, A4, AND A6 PCBs

6H-1 COARSE LOOP ASSEMBLIES: A3, A4, AND A6 PCBs

This section contains service information for the coarse loop assemblies listed in Table 6H-1 below. Refer also to the general reference information in sections 6A, 6B, and 6C.

Table 6H-1. Coarse Loop Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6H-2	6H-1
Block Diagram	Fig. 6H-6	6H-11
Troubleshooting	Tbl. 6H-2	6H-7
PCB LEVEL		
A3 Coarse Loop Mixer PCB		
Detailed Circuit Description	Para. 6H-3	6H-2
Troubleshooting	Tbl. 6H-2	6H-7
Parts Locator Diagram	Fig. 6H-7	6H-12
Schematic (Sheet 1 of 1)	Fig. 6H-8	6H-13
A4 Coarse Loop Oscillator		
Detailed Circuit Description	Para. 6H-4	6H-2
Troubleshooting	Tbl. 6H-2	6H-7
Parts Locator Diagram	Fig. 6H-9	6H-14
Schematic (Sheet 1 of 1)	Fig. 6H-10	6H-15
Parts Locator Diagram*	Fig. 6H-11	6H-16
Schematic (Sheet 1 of 1)*	Fig. 6H-12	6H-17
* Newer Version		
A6 Coarse Loop Divider PCB		
Detailed Circuit Description	Para. 6H-5	6H-3
Troubleshooting	Tbl. 6H-2	6H-7
Parts Locator Diagram	Fig. 6H-13	6H-18
Schematic (Sheet 1 of 2)	Fig. 6H-14	6H-19
(Sheet 2 of 2)	"	6H-20

6H-2 COARSE LOOP ASSEMBLIES, OVERALL DESCRIPTION

Refer to the block diagram in Figure 6H-6 for the following discussion.

The Coarse Loop is comprised of the A3 Coarse Loop Mixer PCB, the A4 Coarse Loop Oscillator PCB, and the A6 Coarse Loop Divider PCB.

The primary function of the Coarse Loop is to provide the coarse tuning frequency for the YIG oscillators. The A4 Coarse Loop Oscillator PCB has a voltage-controlled oscillator (VCO) using a varactor diode to generate an output frequency of 396-440 MHz. The oscillator output is buffered then delivered to the A3 Coarse Loop Mixer PCB. The oscillator signal is mixed with a fixed 500 MHz reference signal from the A5 Reference Oscillator PCB to generate a resulting intermediate frequency (IF). This 60-104 MHz IF signal passes through a 120 MHz low pass filter, then goes to a limiter/amplifier that prevents amplitude modulated noise from being translated to frequency modulated phase noise errors in the following A5 PCB phase/frequency detector circuit.

The amplified and limited IF signal is now divided by a series of circuits – first integer dividers, then fractional division circuits. The integer divider circuits provide 2 MHz frequency steps of the A4 VCO. The A6 phase/frequency detector compares these steps to a 2 MHz reference signal that is derived from a 10 MHz Reference Loop output signal (previously divided by 5 on the Reference loop's A10 Reference Buffer PCB). The phase/frequency output signal is used to tune the A4 PCB's VCO.

At high YIG oscillator frequencies, steps finer than 2 MHz are needed. The A6 fractional divide circuits provide this capability under control of serial data input from the A8 Serial I/O PCB (which is controlled by the A23 Microprocessor from information derived by the DVM circuits on the A17 Analog Instruction PCB).

6H-3 A3 COARSE LOOP MIXER, DETAILED CIRCUIT DESCRIPTION

Refer to the A3 PCB schematic in Figure 6H-8 for the following discussion.

6H-3.1 Local Oscillator (LO) Input

The 500 MHz LO input to A3J2 comes from A5J2 on the A5 Reference Oscillator PCB at a level of +7 dBm. It goes to a 6 dB attenuator consisting of R11, R12, and R13. From the attenuator, the +1 dBm signal goes to the Q2 amplifier where it is amplified to +7 dBm again. This attenuation and amplification isolates the signal, thus preventing it from reflecting back into the A5 Reference Oscillator PCB and causing spurious responses.

R14 and R15 biases Q2 for a collector current of 11 mA. C9 couples the signal from the collector of Q2 to the U1 double balanced mixer.

6H-3.2 RF Input

The 396-440 MHz coarse loop signal comes from A4J2 and goes to A3J3. R1, R2, and R3 attenuate the signal by 20 dB. This provides isolation, preventing the 500 MHz reference oscillator signal and the IF from the mixer from reflecting into the coarse loop oscillator.

The –20 dBm signal on the base of Q1 is amplified by 9 dB, thereby providing a –11 dBm signal level at its output. This signal goes to a 6 dB attenuator consisting of R9 and R10. R4 and R5 bias Q1 for a collector current of 5 mA. The –17 dBm signal then goes to the U1 mixer where it mixes with the 500 MHz LO signal. The resulting IF signal is approximately –26 dBm at this point and covers a frequency range of 60 to 104 MHz.

6H-3.3 Limiter/Amplifier

From the mixer, the IF signal goes to a five-element low pass filter consisting of L2, L3, C10, C11, and C12. R18 provides the proper termination for the mixer and low pass filter. At this point, the IF signal is approximately –29 dBm. C13 couples this signal to Q3, providing a gain of approximately 23 dB. R19 and R20 bias Q3 for a collector current of 5 mA. C15 couples the IF signal to Q4 and Q5 which are arranged as an ac-coupled (by C16) differential amplifier. When not limiting, Q4 and Q5 have a gain of about 12 dB. With a –6 dBm input signal, Q4 and Q5 have a gain of about 6 dB. This limiting prevents any AM on the IF signal from showing up as FM in the phase detector. This would degrade the phase noise performance of the oscillator.

R23 and R24 bias Q4 to yield a collector current of about 3.6 mA and R29 and R30 bias Q5 for a collector current of about 3.6 mA. When the signal on the base of Q4 increases beyond a certain point, the maximum current of Q5 will no longer allow amplification. As the input to Q4 increases, the output of Q5 remains constant. The output of Q5 goes to the Q6 emitter follower which has a nominal 8 mA collector current. From there, the signal goes to A6J1 on the A6 Coarse Loop Divider PCB. R34 provides the 50 Ohm source match of the output, and C21 blocks the dc component on the Q6 emitter from being applied to the A6 PCB.

6H-4 A4 COARSE LOOP OSCILLATOR, DETAILED CIRCUIT DESCRIPTION

Refer to the A4 PCB schematic in Figure 6H-10 for the following discussion.

6H-4.1 Input Amplifier

The phase detector error signal, from the A11 Coarse Loop Divider PCB, goes to P1-7 and then to U1A, a unity gain differential receiver. From U1A, it goes to a four-element low pass filter consisting of L10, C25, L11, and C27. This low pass filter reduces the 2 MHz power level of the error signal to bring the 2 MHz sidebands on the VCO output within acceptable limits. In order to keep the sidebands off the final RF output, they must be at least –109 dBc. The filter also reduces the 600 kHz, 800 kHz, and 1 MHz fractional division sidebands to –41 dBc, –28 dBc, and –89 dBc, respectively.

6H-4.2 Loop Amplifier

From the low pass filter, the signal goes to U1B, the loop amplifier. R26 and C21 set the loop response to approximately 25 kHz. As the oscillator tunes to a lower frequency, its output frequency versus its input voltage (on the varactor tuning diodes) increases, causing a change in loop gain. When the tuning voltage goes negative (approximately –0.6V) at the output of U1B, CR5 starts conducting and puts R27 and C29 in parallel with R26 and C21. This reduces the loop bandwidth to compensate for the increased gain caused by the increased tuning sensitivity of the VCO. The increased sensitivity results from the nonlinearity of the CR1 and CR2 varactor diodes. The voltage at which CR5 conducts is set by CR6, CR7, and R29. CR6 provides temperature compensation for CR7.

The output of the loop amplifier goes to the CR1 and CR2 varactor tuning diodes through R10 and C14 filter network. It also goes to a voltage divider consisting of R22 and R24. The voltage, filtered by C28, and the current, limited by R23, go to the DVM circuits on the A17 Analog Instruction PCB where they are then monitored by the A23 Microprocessor.

NOTE

> Pressing <Shift> TRIGGER O12 displays the voltage on the front panel LEVEL display for troubleshooting and calibration.

The parallel configuration of CR1 and CR2 forms a series resonant tank circuit with the resonator transmission line. C8 and C9 prevent the dc tuning voltage from being applied to the transmission line. L4 and L5 decouple any RF signal present on the tuning diodes from the tuning voltages. Since the output range of U1B can go from approximately +13V to –13V, the tuning diodes are biased with a reference voltage of –15V to prevent them from being forward biased; R9 supplies this voltage, and C10 and C11 filter it. This allows a voltage swing on the varactor diodes of approximately 26V, thereby enabling the Q3 oscillator to be tuned throughout its 396-440 MHz frequency range.

6H-4.3 Oscillator

Q3, a modified Hartley oscillator, couples its feedback from the transmission line to its base via a jumper coupling loop. R15 and R8 furnish collector voltage while R12 and R14 set collector current. C18, C20, C22, and C23 provide decoupling to prevent any RF signal from going into the power supplies. C19 has a fine frequency adjustment to center its range in the center of the varactor diodes' range.

6H-4.4 Buffer Amplifiers

Q1, a buffer amplifier, couples the RF from the resonant transmission line to the base via a coupling loop. R1 and R2 set the collector current. C1 decouples the RF feedback through R2. The RF from the collector of Q1 is coupled through a matching network (C7, R13) to A4J1. Then it goes to the A31 Power Amplifier/Multiplier (on the microwave deck).

The Q2 amplifier is the same as the Q1 amplifier except that it couples the RF capacitively instead of inductively. Its output also goes to a matching network consisting of the printed circuit transmission line (C12). The output from J2 goes to the A3 Coarse Loop Mixer PCB where it mixes with the 500 MHz output from the A5 Reference Oscillator PCB.

6H-5 A6 COARSE LOOP DIVIDER, DETAILED CIRCUIT DESCRIPTION

Refer to the A6 PCB schematic in Figure 6H-12 for the following discussion.

6H-5.1 10 MHz Reference Input

On sheet 2 of the A6 PCB schematic, A6J2 receives a 10 MHz reference signal input at a level of approximately –2 Bm from A10J2. The signal goes to termination resistor R68 and then to the emitter of Q2. Q2 is configured as a temperature-compensating diode for Q3. Q3 amplifies the signal to TTL levels and applies it to U16, a divider. CR6 improves the 10 MHz input signal rise time by preventing Q3 from becoming saturated. U16 is a presetable decade/biquinary counter that is configured as a divide-by-5. The output of U16 is a 2 MHz TTL-level signal that goes to the U17 phase detector and serves as the reference frequency for the coarse loop divider.

6H-5.2 Coarse Loop Mixer Input

On sheet 1 of the A6 schematic, the –2 dBm, 60-104 MHz input signal to A6J1 (from A3J1) is terminated by R2. C12 couples the signal to Q1 which has a gain of approximately 2. R3 and R4 bias Q1 for a collector current of approximately 10 mA.

6H-5.3 Serial Input Control

The U2 and U6 shift registers control the fractional division control and the two counters. The clock signal from the A8 Serial I/O PCB is an approximately 400 kHz TTL-level signal with a poor rise time. U1 is a Schmitt trigger that improves the rise and fall times of the clock and data signals from the A8 Serial I/O PCB. The signals require two clock pulses per data bit to be transmitted into the shift registers. Since there are two shift registers in series, it requires 16 bits to load all of the counters and fractional division control. Therefore, the A23 Microprocessor requires 32 clock cycles each time it writes to the A6 Coarse Loop Divider PCB. U2 pin 2 receives the data and shifts it to U6.

Once the 32 clock cycles are complete, U2 and U6 outputs remain in a stable condition until the coarse loop divider is written to again. Each time the frequency of the coarse loop oscillator must be changed, the U2 and U6 shift registers receive new data to program its counters and fractional division control.

6H-5.4 Two-Modulus Prescaler

C14 couples the output of Q1 to U10, which is used as a divide-by-5 or divide-by-6, depending on the state of the control input signal on pin 9. R8 and C15 form a bias network that sets the threshold of the pin 15 input. The TTL-level output frequency of U10 goes from 12 MHz to 20.8 MHz in the divide-by-5 mode and 10 MHz to 17.33 MHz in the divide-by-6 mode. U8 pin 11 controls the signal to U10 pin 9. The U3 frame counter controls U5A via the carry output on U3 pin 15, U5B, and the U8 divide-by-6 counter. When the signal on U10-9 is high, U10 divides by 5; when it is low, U10 divides by 6.

NOTE

> Early versions of the 67XXA utilized a pair of 4-input NAND gates on the Q outputs of U3 and U8; they were deleted in later models (A6 PCB Rev. F) and the pin 15 carry output of each is used instead.

6H-5.5 Frame Counter (Divide-by-5/6 Counter)

U3 is a synchronous 4-bit counter configured on pin 1 to count up; the up/down control is tied to +5V. It counts the number of input pulses from U10-7. When the outputs of U3 reach 1111, a carry is generated and the output of U3 pin 15 goes low. This sets the counter for a new count sequence. During the next clock cycle at U5-11, the low output of U3-15 transfers to the U5 flip flop output at pin 9. This output should always be a 2 MHz signal.

At the same time U3 loads for a count of 10, U8 loads for a count of 0. U8-11 goes low after loading. This low causes the input at U10-9 to go high resulting in a divide-by-5 from U10.

For example, at a 400 MHz A4 Coarse Loop Oscillator frequency, the signal at A6J1 is 100 MHz. In this example, U10 is dividing by 5 because the input at U10 pin 9 is low. The U3 counter is loaded for a count of 10 (see Figure 6H-1 for waveforms). After 10 cycles from U10, the counter loads again and counts another 10 cycles. Since U10 is dividing by 5 and U3 is dividing by 10, the net division is 50. The signal at U5-9 is 2 MHz only when the input frequency to U10 is at the 100 MHz point in the range of 60-104 MHz input frequency variation. At this time, a 2 MHz resulting signal is available for phase locking the A4 Coarse Loop VCO.

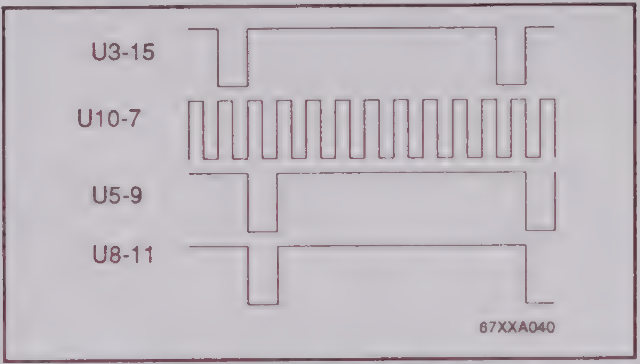


Figure 6H-1. Frame Counter Waveforms

6H-5.6 Divide-by-6 Counter

Figure 6H-2 shows the sequence of events for an A4 VCO frequency of 402 MHz. U8 is the same type counter as U3 and operates the same. The outputs from U8 go to U4 and, when they are all high, the output of U4 goes low. This presets the output at U5-9 to a high, causing U10 to divide-by-5. U10 divides by 5 for 5 cycles at U10-7 if U8 is loaded for a count of 4 at the same time that U3 is loaded for a count of 9, and will divide by 6 for 4 cycles. This means that the division ratio is 54 for 4/9ths of the time and 45 for 5/9ths of the time. This results in [(45 X 5) / 9 = 25] + [(54 X 4) / 9 = 24] = 49. A division ratio of 49 times the 2 MHz reference frequency at U5-9 results in an input frequency of 98 MHz. 500 MHz A5 Reference Oscillator PCB frequency minus the 402 MHz A4 PCB's VCO frequency gives a 98 MHz input frequency to U10.

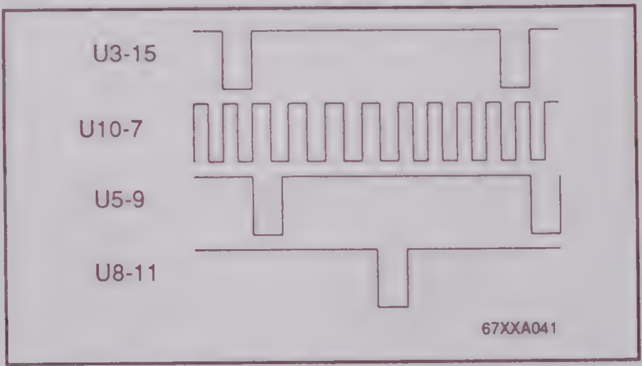


Figure 6H-2. Counter Waveforms (U6 Count = 4)

Figure 6H-3 is the same as Figure 6H-2 except the U8 counter is loaded for a count of 3 instead of 4. This results in [(45 X 6) / 9 = 30] + [(54 X 3) / 9 = 18] = 48. A division ratio of 48 times the 2 MHz reference frequency at U5-9 results in an input frequency to U10 of 96 MHz. 500 MHz A5 reference frequency minus the 404 MHz A4 PCB's VCO frequency results in 96 MHz at U10 input.

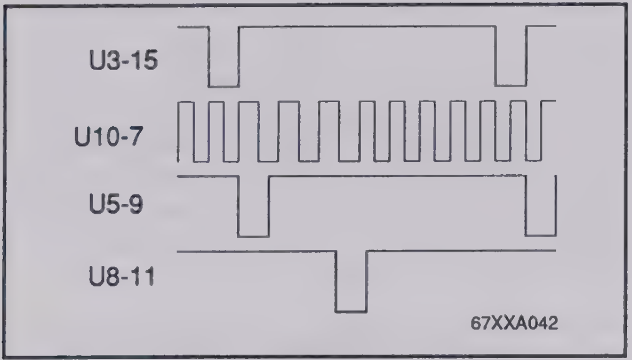


Figure 6H-3. Counter Waveforms (U6 Count = 3)

6H-5.7 Fractional Division Control

The integer division results in 2 MHz steps of the A4 Coarse Loop Oscillator. However, at higher RF output frequencies, 2 MHz steps are insufficient. At an RF output frequency of 18 GHz, the coarse loop frequency is multiplied by 41. This results in the next step of the coarse loop oscillator causing an 82 MHz frequency in the next comb line. Since these comb lines must have a minimum spacing of 20 MHz (Fine Loop Frequency divided by 10), the unit has a frequency gap. To solve this problem, fractional division is used to fill in the gaps. The fractional division results in a coarse loop resolution of 200 kHz. 200 MHz multiplied by 41 results in a 8.2 MHz step for the comb lines. This is well within the 20 to 32 MHz range of the fine loop.

U9 is an adder circuit that controls the U8 counter. When U6 latches the count on its outputs, they go from the input of U9 to the output of U9 and then to the input of U8 unmodified as long as U9-7 is high. When U9-7 goes low, the binary number represented by the outputs of U9 increases by 1. This decreases the count of U8 by 1 as U8 counts up until 1111 is on its outputs.

U7, another type of counter called a rate multiplier, controls the state of U9-7. U7 counts the number of 2 MHz pulses from U5-8. If U7 is programmed for 1 output for each 10 pulses in, every tenth pulse from U5-9 loads U8 for a count of 1 less for that cycle. This means U10 divides-by-5 10% more of the time, resulting in an overall frequency increase of 200 kHz. Using the frequency examples above in the integer division, dividing by 49 for 9 cycles and 48 for 1 cycle results in a division ratio of 48.9 [(49 X 9 + 48) / 10] = 48.9. This results in a frequency of 48.9 X 2 = 97.8 MHz. 500 MHz A5 Reference Oscillator frequency minus 402.2 MHz results in a 97.8 MHz input frequency to U10.

By loading different counts into U7, any 200 kHz step can be obtained between the integer division steps. The output at U7-5 goes low for every input count, however, it remains low only during the loading of U8 for the number of counts programmed into U7 (see Figure 6H-4).

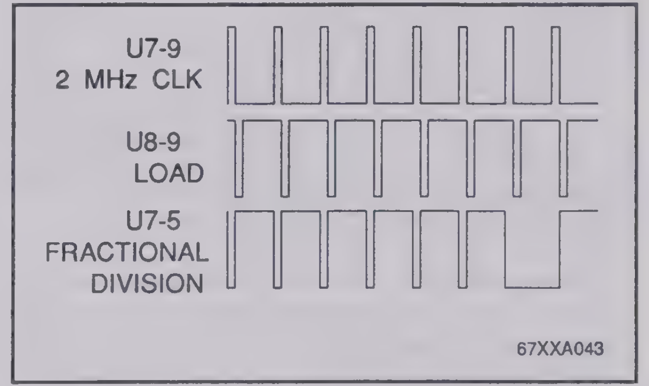


Figure 6H-4. Fractional Division Waveforms

6H-5.8 Phase/Frequency Detector

The U17 phase/frequency detector operates the same as the phase/frequency detector used on the A7 Reference Divider PCB (see the A7 circuit description in section 6G). However, it operates at 2 MHz instead of 10 MHz. The outputs of the phase detector go to the CR2-CR5 diode switches. These diode switches act as steering diodes that switch the decoupled +15V from R15 into the phase detector.

The R16-C24 and R17-C25 filters integrate the 2 MHz pulses into a dc voltage for application to U19. R18 and R19 provide the bias voltage to CR3 and CR5 for proper switching action.

When the outputs at U17-5 and U17-9 are low, CR2 and CR4 conduct and CR3 and CR5 shut off. When the output U17-5 (about 20 ns wide) and U17-9 (about 40 ns wide) go high, CR2 and CR4 will shut off and CR3 and CR5 conduct the current from R13 and R14 into the filter networks. This switching occurs at 2 MHz, (Coarse Loop reference frequency).

The charge on C24 and C25 sums with the current through R18 and R19 and goes to U19. The U19 output is the difference between the two inputs on pins 2 and 3. C26 and C29 provide additional filtering of the 2 MHz reference frequency.

At zero phase difference, the output sensitivity (output pulse width versus phase difference) of the D-type flip-flop phase detector decreases dramatically. When the phase detector operates in this region, this decrease drastically affects the loop gain and thereby, the loop bandwidth. This can cause loop instability and poor phase noise performance of the loop. This point of the phase detector is also called the dead zone or stupid zone.

To overcome this problem, an offset is provided which forces the phase detector to operate at an offset resulting in the two different pulse widths from U17-5 and U17-9. This offset for the coarse loop is approximately 5°. R18 and R19, in addition to providing a bias for CR3 and CR4 diodes, provide this offset by having different values.

If the inputs to U17 are the same frequency at 0 degrees offset, the output pulses from U17-5 and U17-9 are of equal width. Since the inputs to the integrating filters and thereby U17 would be the same, R18, being lower in value than R19, would cause the output of U19 to go slightly negative. However, in a closed loop operation, the loop amplifier on the A4 Coarse Loop Oscillator PCB forces the output of U19 to be 0V when phase locked. The U17-9 output would then have a wider pulse output to counteract the extra current from R18.

6H-5.9 Notch Filters

The phase information contained on the ouput of U19 goes to the notch filters before going to the loop amplifier on the A4 Coarse Loop Oscillator PCB. When the divider is set for fractional division, there is a 200 kHz component and its related harmonics on the output of U19. These 200 kHz components and related harmonics cause 200, 400, 600, and 800 kHz sidebands on the A4 Coarse Loop Oscillator output. The sidebands multiply, along with the Coarse Loop Oscillator signal, and show up on the final RF output. If the 200 kHz sideband is –40 dBc on the Coarse Loop Oscillator output, it results in –8 dBc sidebands on an 18 GHz RF Output signal, assuming there are no other losses in the system. The notch filter reduces these levels so they are typically better than –70 dBc on the final RF output. Notch filters are used since they have much less phase shift at the frequency outside of the notching action and allow a wider loop bandwidth. Active notch filters offer a very high rejection in a smaller size than could be realized with discrete components only.

The A6 Coarse Loop Divider PCB contains three notch filters; two each for 200 kHz and one each for 400 kHz since these are the predominant fraction division sidebands. The 400 kHz low pass filter, located on the A4 Coarse Loop Oscillator PCB, reduces the other harmonically related signals. Figure 6H-5 shows the waveform relationships for a notch filter at resonance.

The first waveform shown is the signal at the junction of R45 and C40, which is the input to the filter. At resonance, C38 and C39 in parallel have a reactance of about 332 Ohms, or about the same value as R47. C40 and C41 has a reactance of about 665 Ohms, or the value of R45 and R46.

The voltage at the junction of C40, R47, and C41 leads the input voltage by 45°. The voltage at the juction of R45, C38, C39 and R46 lags by 45°. The resulting current in R46, therefore, lags the input voltage by 45°. Since the current in C41 leads the voltage by 90°, the resulting current into the summing node at U20-5 leads the input voltage by 135°. This results in the two currents being cancelled, since they are 180° out of phase.

The current at the summing node changes phase and amplitude at either side of the resonance. This produces a voltage drop which is amplified by U20B, a unity gain buffer. The output of U20B also goes to U20A through resistive divider R50 and R51. U20A provides positive feedback to the twin-T filter network, causing a sharper notching action of the filter. Off resonance, the output of U20A is slightly less than the output of U20B. The output of U20A, which is in phase with the input of U20B, reduces the phase shift caused by C38, C39, and R32 by making the capacitor seem very small in value, and the resistor seem very large in value. The gain of U20A determines the sharpness of the filter. The gain of U20A is set so that, with the tolerance of the components in the twin-T network, the notch has sufficient rejection of the unwanted signal.

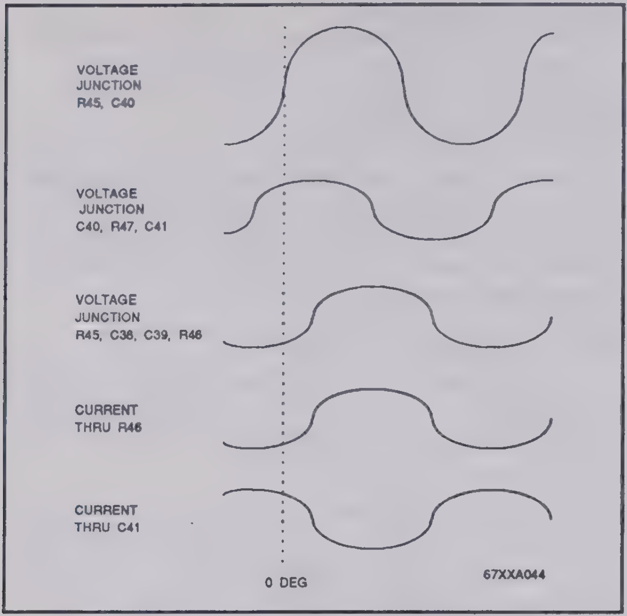

VOLTAGE JUNCTION R45, C40
VOLTAGE JUNCTION C40, R47, C41
VOLTAGE JUNCTION R45, C38, C39, R46
CURRENT THRU R46
CURRENT THRU C41
0 DEG
67XXA044

Figure 6H-5. Notch Filters at Resonance

U21 is a 400 kHz notch filter and U22 is an additional 200 kHz notch filter. R43 and R44 provide a monitor point for the A17 Analog Instruction DVM circuit. The A23 Microprocessor monitors this point via the DVM to determine if the Coarse Loop is phase locked or not. When the Coarse Loop is phase locked, the voltage at P1-5 stays very close to 0V.

6H-6 COARSE LOOP ASSEMBLIES, TROUBLESHOOTING

Troubleshooting procedures in Table 6H-2 cover the A3 Coarse Loop Mixer PCB, A4 Coarse Loop Oscillator PCB, and the A6 Coarse Loop Divider PCB.

6H-7 COARSE LOOP ASSEMBLIES, SERVICE SHEETS

Table 6H-1 on the first page of this section presents the arrangements of the block diagrams, schematics, and parts locater diagrams for the A3, A4 and A6 PCBs.

Table 6H-2. Coarse Loop Troubleshooting (1 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A3 Coarse Loop Mixer PCB Troubleshooting
	Before troubleshooting any of the boards associated with the Coarse Loop (A3, A4, A6), ensure that the reference loop (A5, A7, and A10) is operating properly. Connect A3J2 to A5J2 on the Reference Oscillator. Connect a sweeper or synthesizer, in the frequency range of 350 to 440 MHz at 0 dBm output, to A3J3. Connect a spectrum analyzer to A3J1. While sweeping from 350 MHz (150 MHz IF) to 440 MHz (60 MHz IF), a signal of approximately 0 dBm should appear on the analyzer display. The limiter/amplifier is operating properly if only a few tenths of a dB change appears when the input power is increased or decreased by 3 dB from 0 dBm. By decreasing the input power to about –10 to –20 dBm, the output should decrease; this indicates that the limiter is no longer limiting. If, at 380 MHz (120 MHz IF), the J1 output decreases and at 350 MHz (150 MHz IF), the power drops by about 15 to 20 dB, the A3 PCB is operating properly. If the A3 is not operating properly, check the bias voltages on the transistors (shown on the schematic) with a DVM. A defective transistor or decoupling network can be localized very quickly this way. When a probe is used with a spectrum analyzer to trace a signal, the power level and frequency of an RF signal is easy to see. For the power level, however, it may be necessary to calibrate the probe with a known power level at the frequency of interest. Normally, in this frequency range, a high quality X1 oscilloscope probe can be used with the spectrum analyzer, however, either the probe or the spectrum analyzer must be AC coupled. The spectrum analyzer usually has the maximum allowable DC voltage input indicated on the front panel. A 500 pF capacitor can be added in series with the scope probe tip if the spectrum analyzer is not AC coupled. Keep the capacity leads as short as possible or use one of the capacitor leads as a probe tip. The voltages and power levels shown on the schematic are nominal power levels. The unit operates efficiently with the voltages varying approximately 5-10% and the power levels varying 2-3 dB. Normally, the power level variations are not on the A3 board itself, but are a result of circuit loading by the test setup or inaccuracies in the measurement equiment.

Table 6H-2. Coarse Loop Troubleshooting (2 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A4 Coarse Loop Oscillator Troubleshooting
	Measuring the phase noise of the A4 Coarse Loop Oscillator requires either a very sophisticated phase noise measurement system or a very sophisticated spectrum analyzer. The phase noise of the 67XXA at 10 GHz is specified at –70 dBc (1 kHz away from the carrier in a 1 Hz bandwidth). Since the phase noise of the coarse loop is multiplied along with the frequency, the coarse loop phase noise must be better than –98 dBc: 20 X Log(10,000/400) = 28 dB (–70 + –28 = –98 dBc) For example, the Tektronics 494 spectrum analyzer has noise sidebands that are specified for –70dBc in a 100 Hz bandwidth. When resolved to a 1 Hz bandwidth, the sidebands equal –90 dBc. To measure the phase noise of the 494 at 400 MHz, connect it to the Coarse Loop Oscillator. SHIFT, TRIGGER, 012 displays the frequency of the Coarse Loop Oscillator on the 67XXA FREQUENCY display, and the VCO tuning voltage on the LEVEL display. Adjusting the DECREASE/INCREASE keys increment the Coarse Loop frequency by as little as 200 kHz steps. The increment size can also be set. To measure the output at A4J2, connect A4J1 to A3J3. This allows the Coarse Loop to remain phase locked. When observing the A4J1 or A4J2 signal on a spectrum analyzer, several sidebands appear. These sideband frequencies result from the reference frequency (2 MHz) of the phase detector and, at any frequency between the 2 MHz increments of the reference frequency, fractional division. These signals must be at certain maximum levels in order to not appear on the final RF output and to not cause locking problems. These frequencies are shown below with their maximum acceptable levels. • 50 KHz –81 dBc (switching power supply) • 100 KHz –69 dBc (switching power supply) • 200 KHz –46 dBc (fractional division) • 400 KHz –54 dBc (fractional division) • 600 KHz –41 dBc (fractional division) • 800 KHz –28 dBc (fractional division) • 1 MHz –89 dBc (fractional division) • 2 MHz –109 dBc (reference frequency) • 4 MHz –109 dBc (reference frequency) A decoupling network is defective on either the A3, A4, or A6 PCB if the 50 kHz and/or 100 kHz sidebands are out of spec. The A4 board is the most sensitive. Also, these sidebands must be measured with the boards installed in the casting. The 200 kHz or 400 kHz notch filters on the A6 PCB are defective if the 200 kHz or 400 kHz sidebands are out of spec (see A6 PCB troubleshooting). If any of the sidebands above 400 kHz are out of spec, either the phase detector integrator filters on the A6 board (2 MHz) or the low pass filter on the output of the loop amplifier (A4U1) is defective. **NOTE** Except for U1 and its associated components, or Q1 and Q2, do not try to replace any of the oscillator components associated with Q3. Use extra care in handling the board and do not bend the coupling loops or move any of the capacitors associated with the Q1, Q2, and Q3 circuits. Q3 is difficult to replace. Even changing the amount of solder on its leads or overheating the transistor can degrade its performance to where it no longer operates. When replacing Q1 or Q2 make the leads as short as possible to reduce lead inductance. Replacing these transistors can be very difficult. It's easier to replace the board with an exchange board.

Table 6H-2. Coarse Loop Troubleshooting (3 of 4)

Trouble / Error Code	Troubleshooting Procedure
	Normally, no adjustments are needed when replacing an A4 exchange PCB although C19 may need adjustment in some cases. Follow the procedure under the E4-13 error code.
E4-10	This error code test checks the A6 phase detector output voltage. If the A4 Coarse Loop Oscillator is locked, it then checks to see if calibration is required. If the A4 is not phase locked, the processor performs the E4-11 through E4-13 tests to further localize failure. The E4-10 error code indicates that the processor was not able to localize the failure mode by using the E4-11 through E4-13 code tests. This indicates a failure in either the A3, A4 or A6 PCB. To troubleshoot, perform E4-12 and E4-11 error code troubleshooting tests.
E4-11	The processor has determined that the Coarse Loop is not phase locked. It checks if the error voltage is negative. If it is negative, the most likely cause is a failure in the 10 MHz reference signal supplied by the A10 Reference Buffer PCB. • Connect a spectrum analyzer to A10J2. The spectrum analyzer should indicate a 10 MHz signal of approximately 0 dBm. If there is no 10 MHz signal, go to the A10 troubleshooting in section 6G. If there is a 10 MHz signal, reconnect A6J2 cable to A10J2. • Install the A6 board on an extender. Connect the J1 and J2 connectors to their appropriate destinations with extender cables. With an oscilloscope, check A6TP3 for 2 MHz TTL pulses. If there are no TTL pulses at A6TP3, the A6Q2, Q3, or U16 circuits are defective. If there are TTL pulses at A6TP3, go to A6 Coarse Loop Divider troubleshooting.
E4-12	The processor has determined the coarse loop is not phase locked. It checks if the error voltage is positive. If it is positive, the most likely cause is a failure in the 396-440 MHz output of the A4 Coarse loop Oscillator PCB or the A3 Coarse Loop Mixer PCB. Connect a spectrum analyzer to A4J1. The spectrum analyzer should display a signal at approximately 396 MHz or less at approximately –1 to –3 dBm. If not, go to the A4 Coarse Loop Oscillator troubleshooting. If the signal is present, connect the spectrum analyzer to A4J2 and connect the cable that was on A4J2 to A4J1. There should be a signal of approximately 396 MHz or less at –1 to –3 dBm. If this signal is present, go to the A3 Coarse Loop Mixer troubleshooting. If it is not present, go to the A4 Coarse Loop Oscillator troubleshooting.
E4-13	**CAUTION** The following calibration of the Coarse Loop Oscillator frequency should be under taken only when the E4-13 error code is displayed; it should not be performed as a routine calibration. Use caution in handling the board. If the coupling loops are moved, it will require factory recalibration. Install the A4 PCB on an extender board. Connect a frequency counter to A4J1. Remove the connection between A4J2 and A3J3. Adjust A4C19 for 442 ±1 MHz. Press SHIFT, TRIGGER, 012. Press 4, 4, 0, MHz. Reconnect A4J2 to A3J3. The level display should indicate approximately +11V. Note and record the reading. Remove A4 from the extender, and reinstall A4. Note the LEVEL display indication. Subtract this reading from the ≈11V reading noted above. Reinstall A4 on the extender board. Adjust C9 until the LEVEL display indicates the first recorded reading plus the difference between the first and second reading ±0.02V. *Example:* Assume the first reading is 11.00V and that the second reading is 11.10V. You would adjust C9 for 10.90V ±0.02V [11.00 – 11.10 = –0.1; 11.00 + (–0.1) = 10.90V ±0.02V]. Install the A4 PCB in the RF casting without the extender. The level display should remain at the first recorded indication ±0.05V.

Table 6H-2. Coarse Loop Troubleshooting (4 of 4)

Trouble / Error Code	Troubleshooting Procedure
	A6 Coarse Loop Divider PCB Troubleshooting
10 MHz Input Circuit	If the collector of Q3 does not have a 10 MHz TTL signal, either Q2 or Q3 is defective. The output of U16-12 is a 2 MHz pulse. If not, and there is an input on U16-6, U16 is defective.
CL IF Input	The collector of Q1 has about +3.7 VDC on it. Without an oscilloscope of sufficient bandwidth, the 10-104 MHz input is difficult to see. The RF there is approximately 1 to 2 Vp-p. The output from U10 is the input signal divided by 5 or 6, depending on the state of U10-9. Use SHIFT, TRIGGER, 012 to set the frequency of the dividers. A convenient frequency to set the dividers to is 400 MHz. This provides divide-by-5 action and a 20 MHz output, which can be seen with most oscilloscopes. You can also apply a 100 MHz, 0 dBm signal from an external source to A6J1 to provide a known signal in case the Coarse Loop Oscillator is not operating properly. Using an external signal source as mentioned above, you can step the divider to various frequencies and observe the waveforms as shown in Figures 6H-1 through 6H-5. As an example, if you suspect U9 is operating improperly, note the output on U9 pins 1, 13, 4, and 10. Grounding U9 pin 7 shifts the binary count by one. U7 pin 5 has an output for each input except when fractional division is not being used. Some of these pulses are wider than others, depending on the count programmed into U7.
Phase Detector	Without the 2 MHz clock on U17 pin 13, U17 pin 5 is always high and U17 pin 9 is always low. If the clock on U17 pin 1 is missing, the reverse is true. An external synthesizer can be used when the external reference is connected to the 67XXA EXT 10 MHz INPUT and the output is connected to A6J1. Pulses from U17 pin 5 and U17 pin 9 appear when the Coarse Loop is programmed for 400 MHz and a 100 MHz, 0dBm output comes from the external synthesizer. The width of these pulses depends on the phase relationship of the external synthesizer to the 67XXA time base. Some synthesizers have an adjustable phase allowing the pulse widths of U17 to be changed. The minimum pulse width is approximately 20 ns. The output of U19 pin 6 is monitored by adjusting the phase of the external source. At exactly 0 degrees phase difference, the output of U19 is slightly negative. To check this, lift U17 pin 1 from the PCB and connect it to TP3. This provides 20 ns pulses from U17 pins 9 and 5, and a slight negative voltage at U19 pin 6. The switching of the CR2 and CR5 diodes can be checked this way also. Another way to check U19 is to jumper TP4 to the juction of CR5, C25, and R17. U19 pin 6 again has a slight negative output voltage of approximately 400 mV.
Notch Filters	A defective notch filter appears as 200 or 400 kHz sidebands on the A4 Coarse Loop Oscillator. To check the notch filters, use SHIFT, TRIGGER, 012 to set the Coarse Loop Oscillator to 400 MHz (no fractional division, integer division only) and apply an external oscillator through a 10 KOhm resistor into U19 pin 2. To see where the notches peak, adjust the oscillator approximately by 200 kHz or 400 kHz and observe the outputs of the filter with an oscilloscope. If they do not peak with a few kHz of their intended frequency, then one of the capacitors or resistors in the twin-T network has probably changed value. At the notch frequency, the output of the positive feedband amplifiers (U20A, U21A, and U22A) is 0 VAC. The DC output on the B amplifiers is the same as the output of U19 pin 6. The output of the A amplifiers is less.

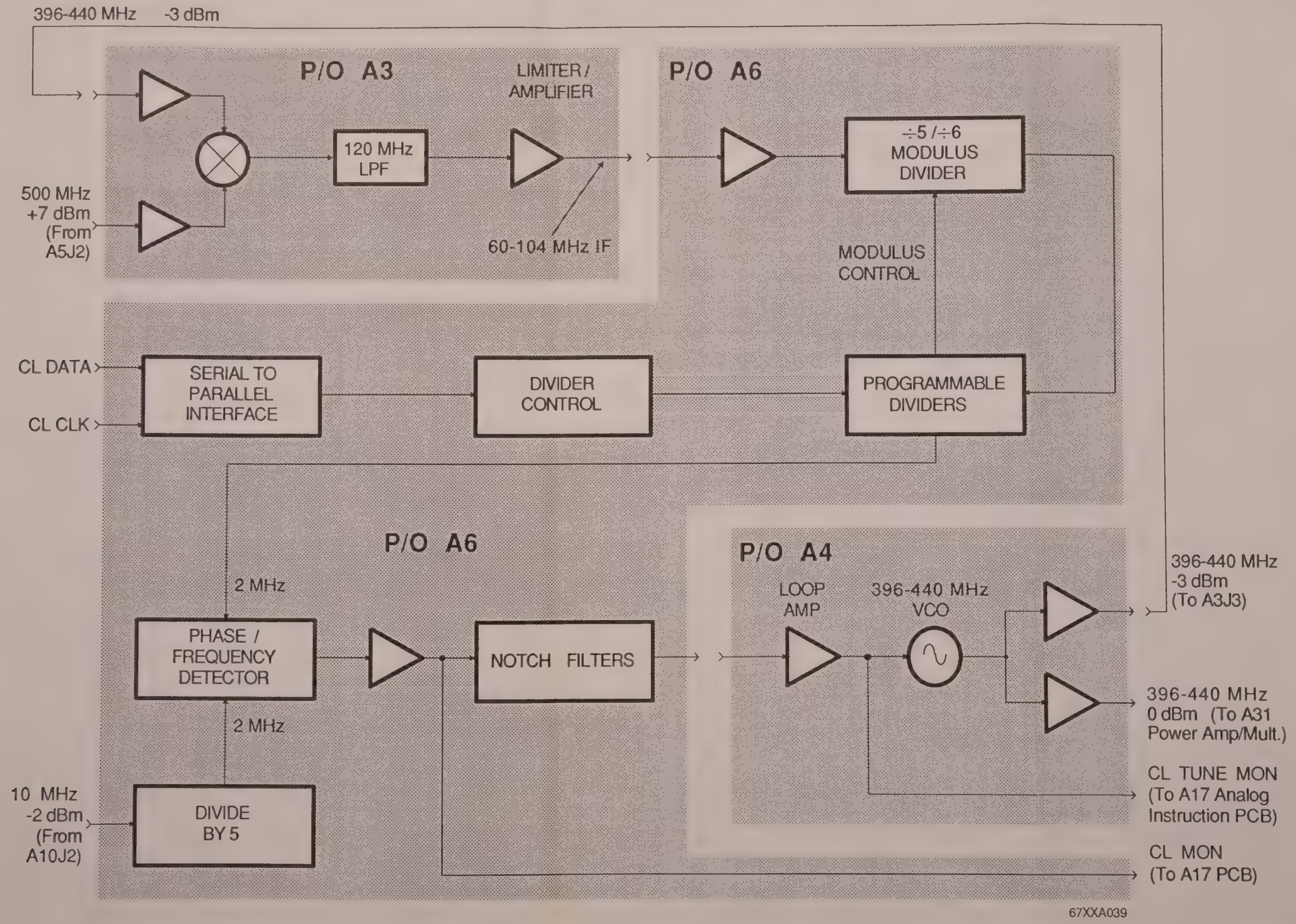
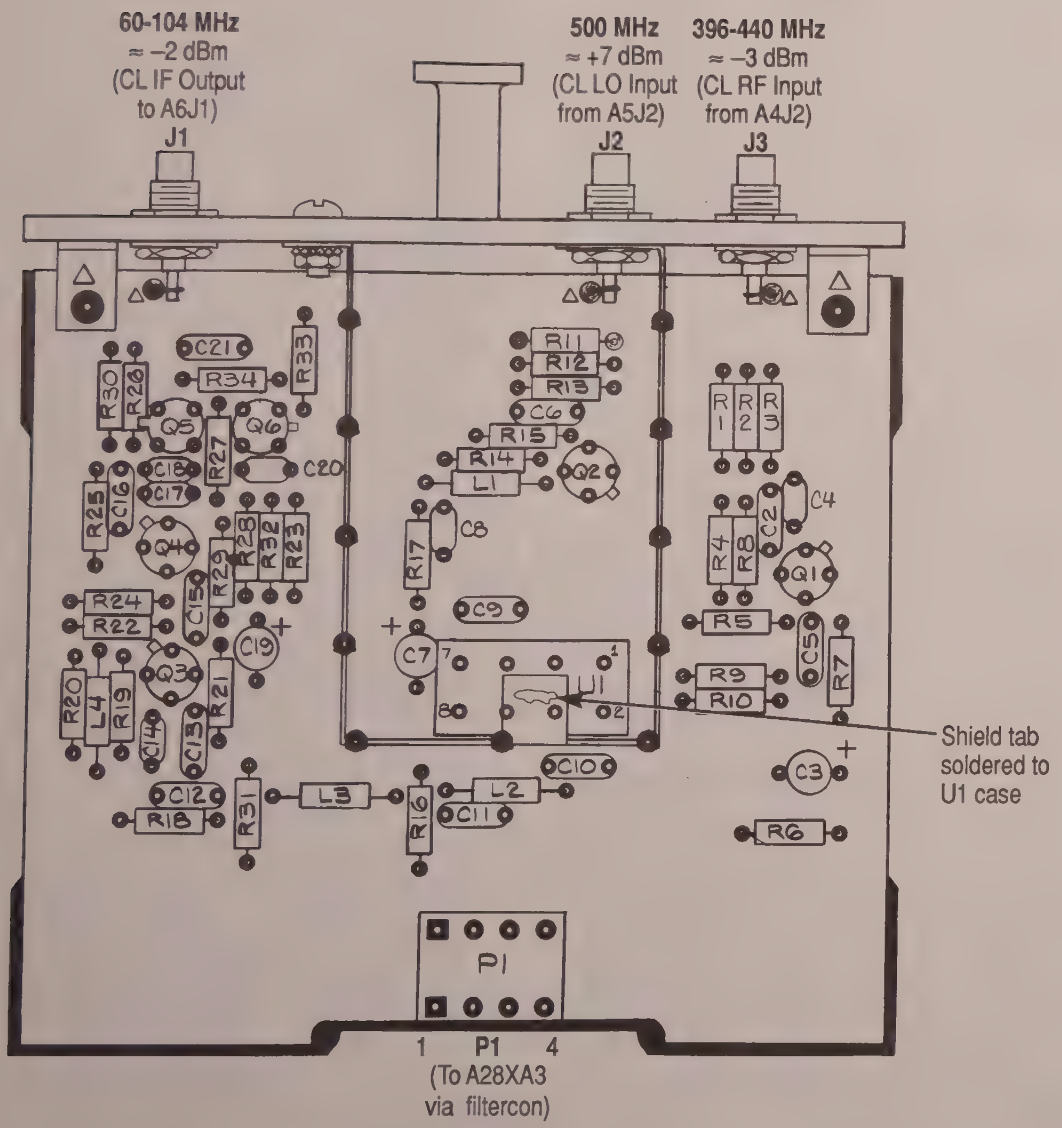

396-440 MHz -3 dBm
P/O A3
LIMITER / AMPLIFIER
P/O A6
500 MHz +7 dBm (From A5J2)
120 MHz LPF
60-104 MHz IF
÷5 / ÷6 MODULUS DIVIDER
MODULUS CONTROL
CL DATA
CL CLK
SERIAL TO PARALLEL INTERFACE
DIVIDER CONTROL
PROGRAMMABLE DIVIDERS
P/O A6
P/O A4
2 MHz
LOOP AMP
396-440 MHz VCO
396-440 MHz -3 dBm (To A3J3)
PHASE / FREQUENCY DETECTOR
NOTCH FILTERS
396-440 MHz 0 dBm (To A31 Power Amp/Mult.)
2 MHz
CL TUNE MON (To A17 Analog Instruction PCB)
10 MHz -2 dBm (From A10J2)
DIVIDE BY 5
CL MON (To A17 PCB)
67XXA039

Figure 6H-6. Coarse Loop Block Diagram


60-104 MHz
≈ −2 dBm
(CL IF Output to A6J1)
J1
500 MHz
≈ +7 dBm
(CL LO Input from A5J2)
J2
396-440 MHz
≈ −3 dBm
(CL RF Input from A4J2)
J3
C21
R30
R26
R34
R33
Q5
Q6
R27
C18
C17
C20
R25
C16
Q4
R28
R32
R23
R29
R24
R22
C15
C19
Q3
R20
L4
R19
R21
C14
C13
C12
R18
R31
L3
R16
C11
L2
C10
R11
R12
R13
C6
R15
R14
L1
Q2
R17
C8
C9
C7
U1
R1
R2
R3
C4
R4
R8
C2
Q1
R5
C5
R7
R9
R10
C3
R6
P1
Shield tab soldered to U1 case
1 P1 4
(To A28XA3 via filtercon)

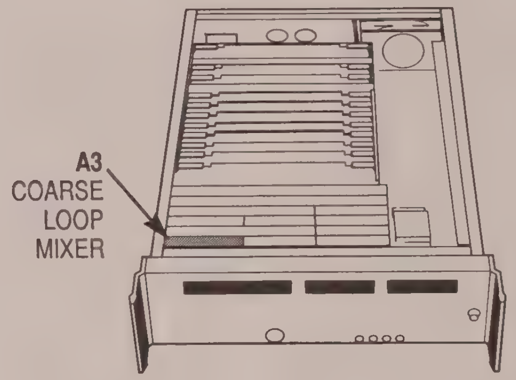
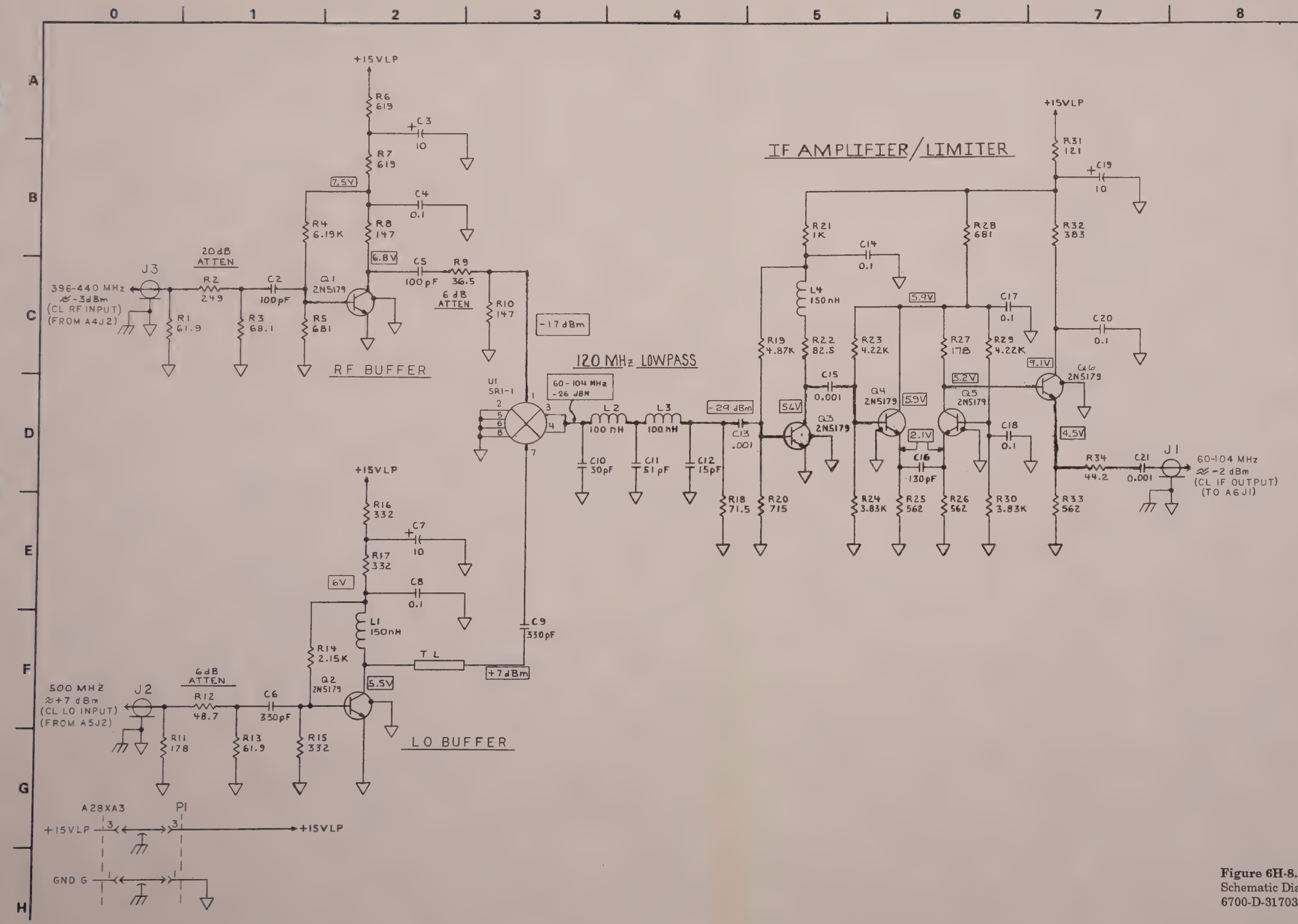

A3
COARSE
LOOP
MIXER

Figure 6H-7. A3 Coarse Loop Mixer PCB Parts Locater Diagram
6700-D-31703-3 (Rev. C)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
+15VLP
R6
619
C3
10
R7
619
7.5V
C4
0.1
R4
6.19K
R8
147
6.8V
C5
100pF
R9
36.5
6 dB
ATTEN
20dB
ATTEN
J3
396-440 MHz
≈-3dBm
(CL RF INPUT)
(FROM A4J2)
R2
249
C2
100pF
Q1
2N5179
R1
61.9
R3
68.1
R5
681
R10
147
-17dBm
RF BUFFER
U1
SRI-1
60-104 MHz
-26 dBm
120 MHz LOWPASS
L2
100nH
L3
100nH
-29 dBm
C13
.001
C10
30pF
C11
51pF
C12
15pF
R18
71.5
R20
715
IF AMPLIFIER/LIMITER
R21
1K
C14
0.1
L4
150nH
R19
4.87K
R22
82.5
5.4V
Q3
2N5179
C15
0.001
R28
681
5.9V
R23
4.22K
Q4
2N5179
5.9V
2.1V
C16
130pF
R24
3.83K
R25
562
R27
178
R29
4.22K
5.2V
Q5
2N5179
R26
562
R30
3.83K
C17
0.1
C18
0.1
+15VLP
R31
121
C19
10
R32
383
C20
0.1
9.1V
Q6
2N5179
4.5V
R34
44.2
C21
0.001
J1
60-104 MHz
≈-2 dBm
(CL IF OUTPUT)
(TO A6J1)
R33
562
+15VLP
R16
332
C7
10
R17
332
6V
C8
0.1
L1
150nH
R14
2.15K
TL
C9
330pF
+7dBm
500 MHz
≈+7 dBm
(CL LO INPUT)
(FROM A5J2)
J2
6dB
ATTEN
R12
48.7
C6
330pF
Q2
2N5179
5.5V
R11
178
R13
61.9
R15
332
LO BUFFER
A28XA3
P1
+15VLP
+15VLP
GND G

A3 COARSE LOOP MIXER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500 pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   CHASSIS GROUND: ⏚

   ISOLATED GROUND: ▽
4. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
5. PCB TRANSMISSION LINE PATHS ARE DENOTED AS: -[TL]-
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   Q1-Q6
7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C21 J3 L4 P1 Q6 R34 U1	C1

Figure 6H-8. A3 Coarse Loop Mixer PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31703-3 (Rev. C)

)

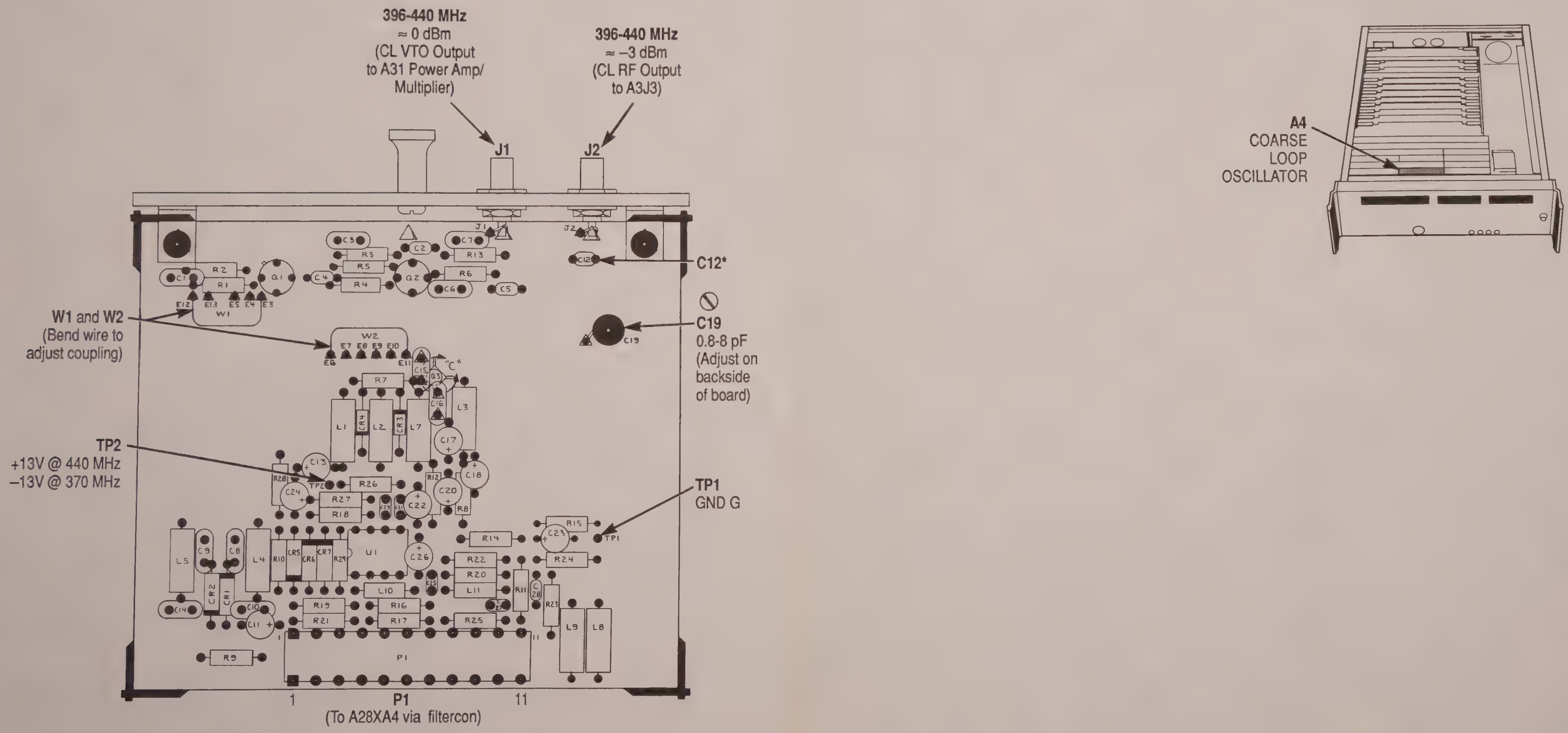
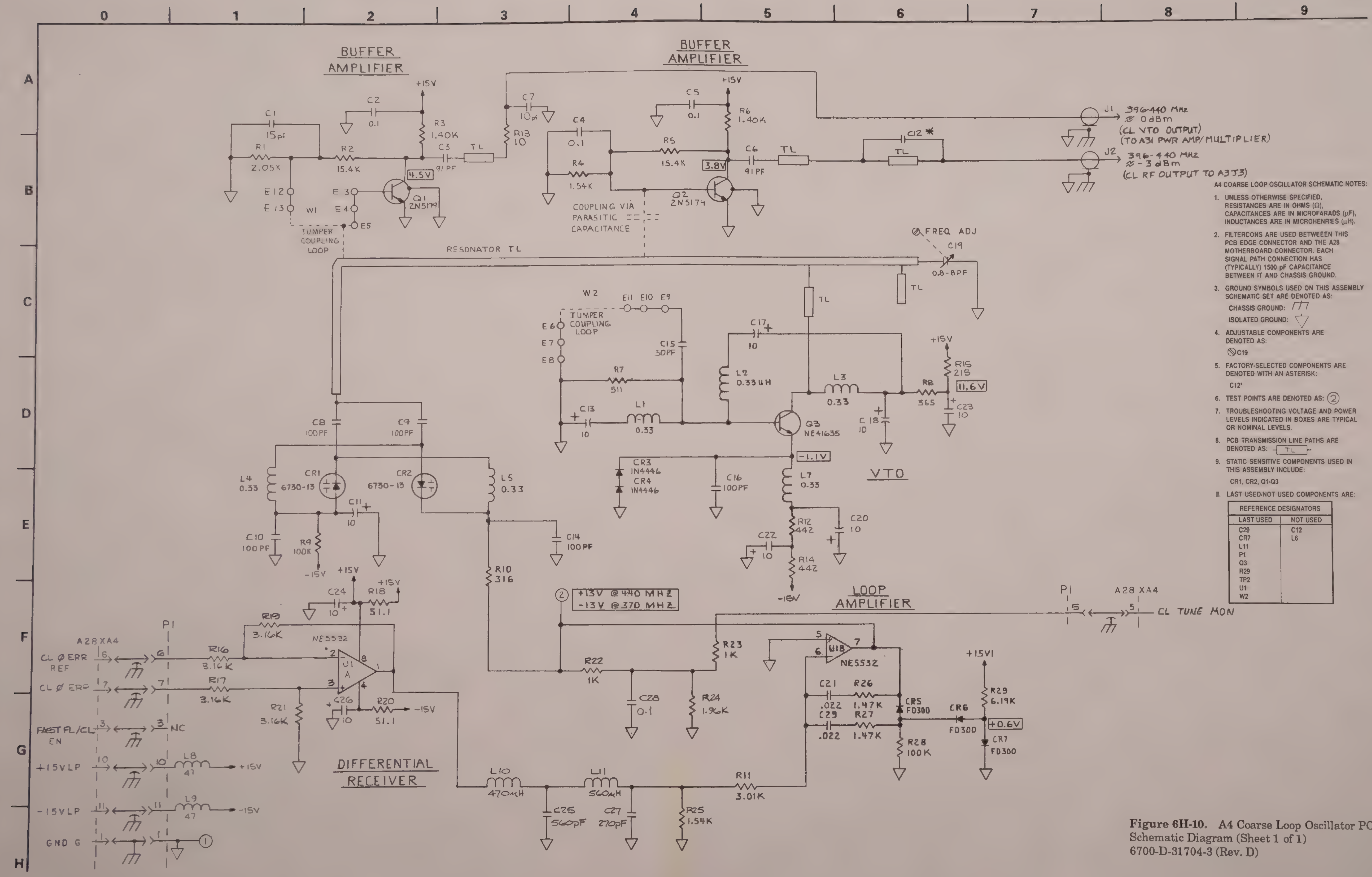

396-440 MHz
≈ 0 dBm
(CL VTO Output
to A31 Power Amp/
Multiplier)
396-440 MHz
≈ –3 dBm
(CL RF Output
to A3J3)
J1
J2
C12*
C19
0.8-8 pF
(Adjust on
backside
of board)
W1 and W2
(Bend wire to
adjust coupling)
TP2
+13V @ 440 MHz
–13V @ 370 MHz
TP1
GND G
1
P1
11
(To A28XA4 via filtercon)
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C13
C14
C15
C16
C17
C18
C20
C22
C23
C24
C26
C28
CR1
CR2
CR3
CR4
CR5
CR6
CR7
Q1
Q2
Q3
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
L1
L2
L3
L4
L5
L7
L8
L9
L10
L11
U1
W1
W2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
"C"
A4
COARSE
LOOP
OSCILLATOR

Figure 6H-9. A4 Coarse Loop Oscillator PCB Parts Locater Diagram
6700-D-31704-3 (Rev. D)

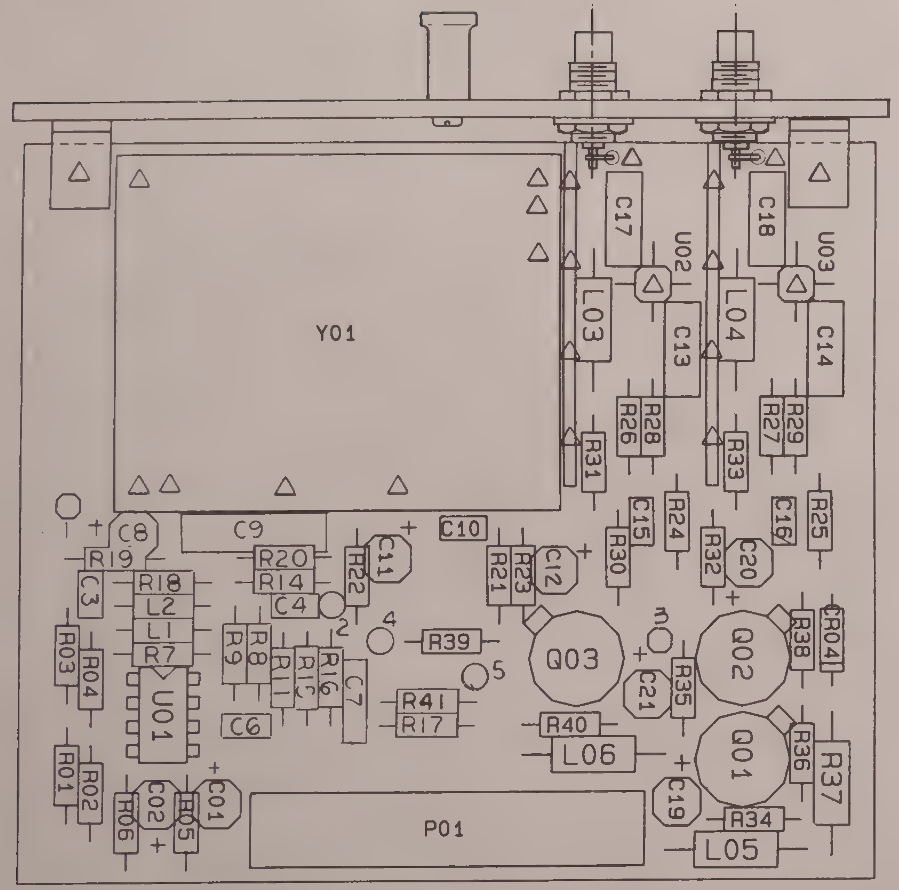

BUFFER AMPLIFIER
BUFFER AMPLIFIER
+15V
C1 15pf
C2 0.1
R1 2.05K
R2 15.4K
R3 1.40K
C3 91 PF
TL
C7 10pf
R13 10
C4 0.1
C5 0.1
R6 1.40K
R4 1.54K
R5 15.4K
3.8V
4.5V
C6 91 PF
Q1 2N5179
Q2 2N5179
E12
E13
W1
E3
E4
E5
JUMPER COUPLING LOOP
COUPLING VIA PARASITIC CAPACITANCE
RESONATOR TL
C12 *
J1 396-440 MHz ≈ 0dBm (CL VTO OUTPUT) (TO A31 PWR AMP/MULTIPLIER)
J2 396-440 MHz ≈ -3 dBm (CL RF OUTPUT TO A3J3)
FREQ ADJ
C19 0.8-8PF
W2
E11 E10 E9
E6 E7 E8
JUMPER COUPLING LOOP
C15 50PF
R7 511
C13 10
L1 0.33
L2 0.33 UH
C17 10
L3 0.33
R8 365
+15V
R15 215
11.6V
C23 10
C18 10
Q3 NE41635
-1.1V
CR3 1N4446
CR4 1N4446
C16 100PF
L7 0.33
VTO
R12 442
C20 10
C22 10
R14 442
-15V
C8 100PF
C9 100PF
L4 0.33
CR1 6730-13
CR2 6730-13
L5 0.33
C11 10
C10 100 PF
R9 100K
-15V
C14 100 PF
R10 316
② +13V @440 MHz -13V @370 MHz
LOOP AMPLIFIER
P1
A28 XA4
5
CL TUNE MON
+15V
C24 10
R18 51.1
R19 3.16K
NE5532
U1 A
A28XA4
P1
CL Ø ERR REF
CL Ø ERR
FAST FL/CL EN
+15VLP
-15VLP
GND G
NC
R16 3.16K
R17 3.16K
R21 3.16K
C26 10
R20 51.1
-15V
L8 47
L9 47
①
DIFFERENTIAL RECEIVER
R22 1K
R23 1K
C28 0.1
R24 1.96K
U1B NE5532
C21 .022
R26 1.47K
C29 .022
R27 1.47K
CR5 FD300
CR6 FD300
+15V1
R29 6.19K
+0.6V
CR7 FD300
R28 100K
L10 470mH
L11 560mH
R11 3.01K
C25 560pF
C27 270pF
R25 1.54K
0 1 2 3 4 5 6 7 8 9
A B C D E F G H

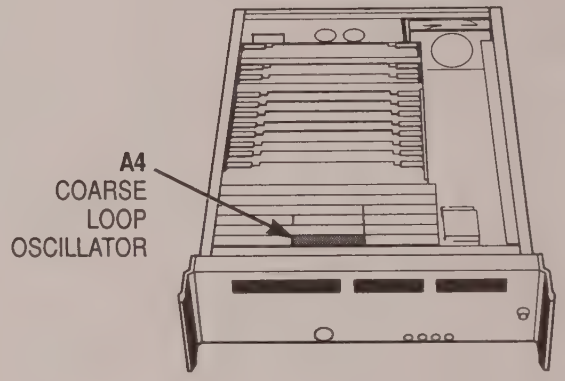
A4 COARSE LOOP OSCILLATOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. FILTERCONS ARE USED BETWEEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500 pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏚
   ISOLATED GROUND: ▽
4. ADJUSTABLE COMPONENTS ARE DENOTED AS:
   ⦸C19
5. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK:
   C12*
6. TEST POINTS ARE DENOTED AS: ②
7. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
8. PCB TRANSMISSION LINE PATHS ARE DENOTED AS: -[TL]-
9. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR1, CR2, Q1-Q3
10. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C29	C12
CR7	L6
L11	
P1	
Q3	
R29	
TP2	
U1	
W2	

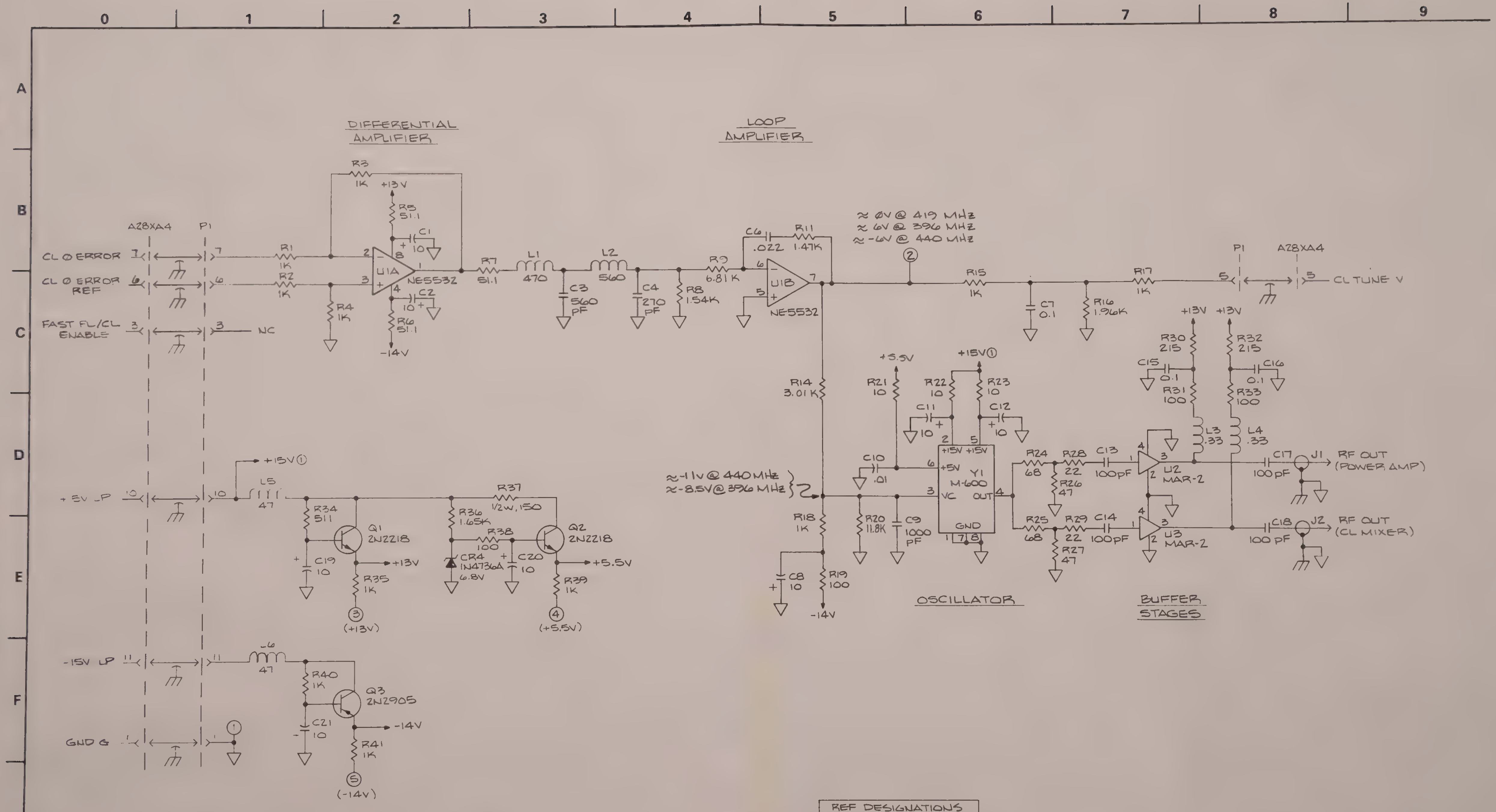
Figure 6H-10. A4 Coarse Loop Oscillator PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31704-3 (Rev. D)


Y01
C17
U02
C18
U03
L03
C13
L04
C14
R26
R28
R27
R29
R31
R33
C15
R24
C16
R25
R30
R32
C20
C8
C9
C10
R19
R20
R14
R22
C11
R21
R23
C12
C3
R18
L2
L1
R7
C4
R03
R04
R9
R8
R16
C7
2
4
R39
Q03
3
5
Q02
R38
CR04
C21
R35
R41
R17
C6
U01
R40
L06
Q01
R36
R37
R01
R02
R06
C02
R05
C01
P01
C19
R34
L05


A4
COARSE
LOOP
OSCILLATOR

NOTE:
This is a newer version of the A4 Coarse Loop Oscillator PCB that is provided on later models. The older version is shown in Figures 6H-9 and 6H-10.

Figure 6H-9. A4 Coarse Loop Oscillator PCB Parts Locator Diagram (Newer Version)
6700-D-31804-3 (Rev. B)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
DIFFERENTIAL AMPLIFIER
LOOP AMPLIFIER
A28XA4
P1
CL Ø ERROR
CL Ø ERROR REF
FAST FL/CL ENABLE
NC
R1 1K
R2 1K
R3 1K
+13V
R5 51.1
C1 10
U1A
NE5532
C2 10
R4 1K
R6 51.1
-14V
R7 51.1
L1 470
L2 560
C3 560 pF
C4 270 pF
R8 1.54K
R9 6.81K
C6 .022
R11 1.47K
U1B
NE5532
≈ ØV @ 419 MHz
≈ 6V @ 396 MHz
≈ -6V @ 440 MHz
②
R15 1K
C7 0.1
R16 1.96K
R17 1K
CL TUNE V
+13V
R30 215
R32 215
C15 0.1
C16 0.1
R31 100
R33 100
L3 .33
L4 .33
R14 3.01K
+5.5V
+15V①
R21 10
R22 10
R23 10
C11 10
C12 10
C10 .01
Y1 M-600
+15V
+5V
VC
OUT
GND
≈-1V @ 440 MHz
≈-8.5V @ 396 MHz
R18 1K
R20 11.8K
C9 1000 pF
C8 10
R19 100
R24 68
R28 22
R26 47
C13 100pF
U2 MAR-2
R25 68
R29 22
R27 47
C14 100pF
U3 MAR-2
C17 100 pF
J1
RF OUT (POWER AMP)
C18 100 pF
J2
RF OUT (CL MIXER)
OSCILLATOR
BUFFER STAGES
+5V LP
L5 47
R34 511
Q1 2N2218
C19 10
+13V
R35 1K
③ (+13V)
R36 1.65K
R37 1/2W, 150
R38 100
CR4 1N4736A 6.8V
C20 10
Q2 2N2218
+5.5V
R39 1K
④ (+5.5V)
-15V LP
L6 47
R40 1K
Q3 2N2905
C21 10
-14V
R41 1K
⑤ (-14V)
GND G
①

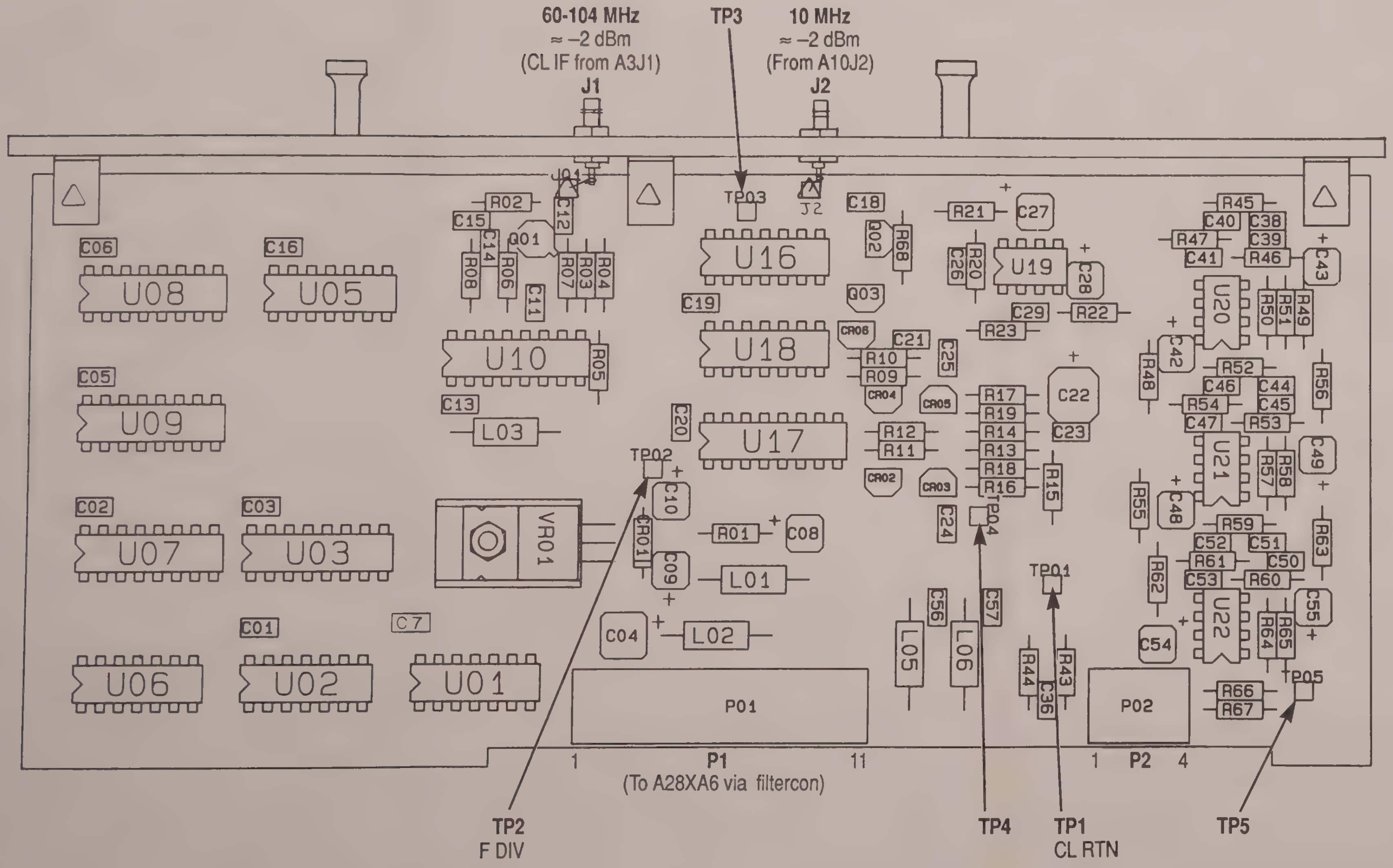
NOTES:

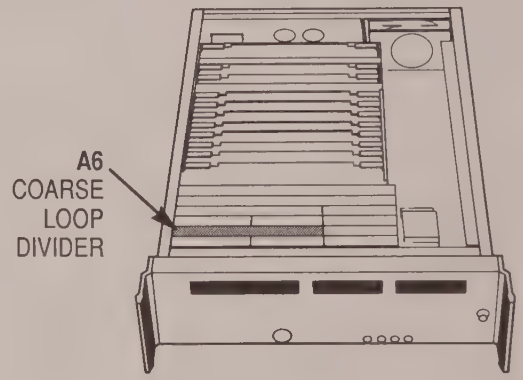
UNLESS OTHERWISE SPECIFIED,
RESISTANCES ARE IN OHMS.
CAPACITANCES ARE IN MICROFARADS.
INDUCTANCES ARE IN MICROHENRIES.

REF DESIGNATIONS	
LAST USED	NOT USED
U3 Q3 CR4 L6 Y1 R41 C21 TP5	C5 R10, R12, R13 CR1-3

NOTE:
This is a newer version of the A4 Coarse Loop Oscillator PCB that is provided on later models. The older version is shown in Figures 6H-9 and 6H-10.

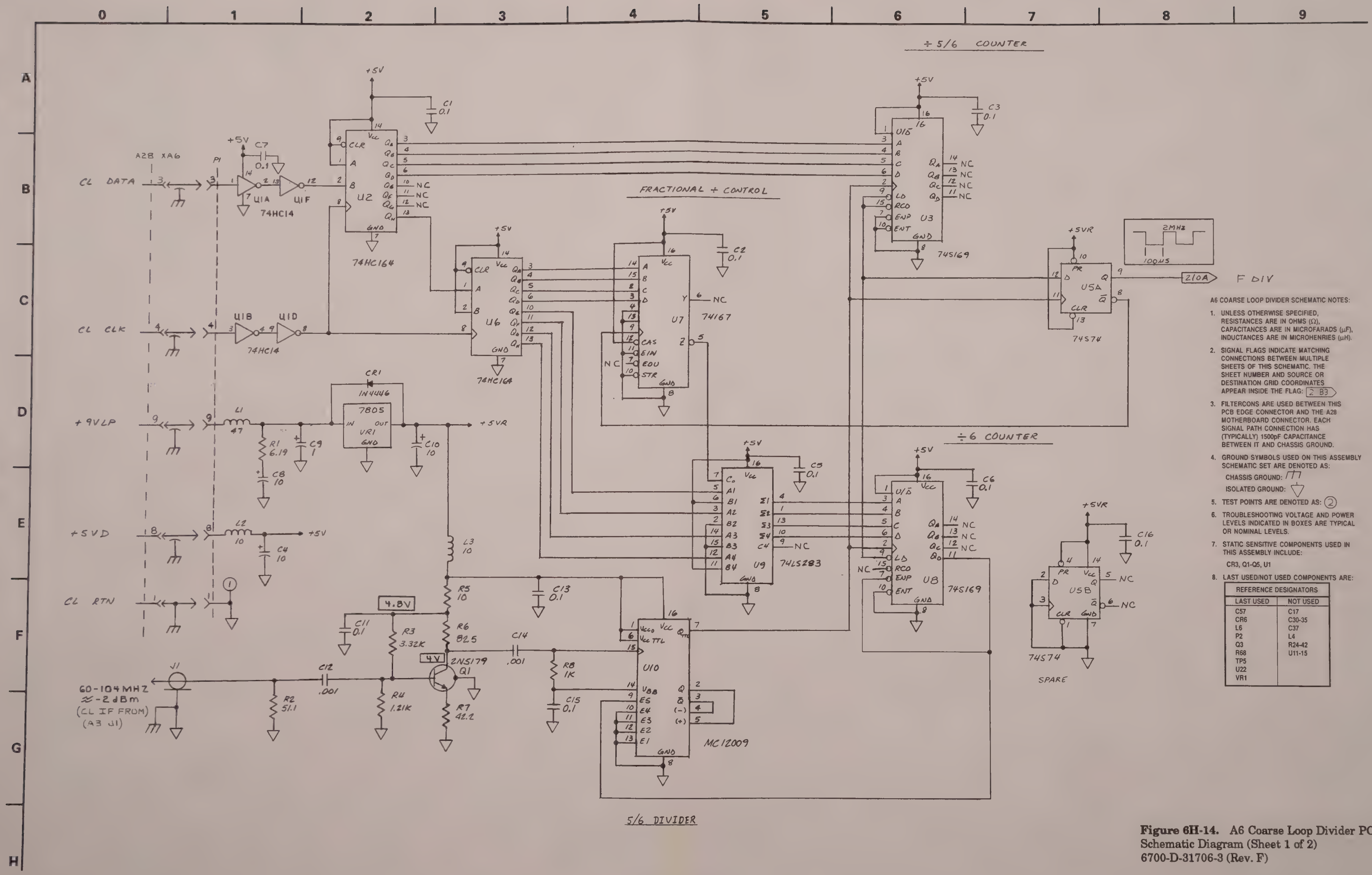
Figure 6H-10. A4 Coarse Loop Oscillator PCB (Newer Version)
Schematic Diagram (Sheet 1 of 1)


60-104 MHz
≈ −2 dBm
(CL IF from A3J1)
J1
TP3
10 MHz
≈ −2 dBm
(From A10J2)
J2
J01
TP03
J2
C06
U08
C16
U05
C05
U09
C02
U07
C03
U03
C01
C7
U06
U02
U01
R02
C15
C12
Q01
C14
R08
R06
R07
R03
R04
C11
U10
R05
C13
L03
U16
C19
U18
C20
U17
TP02
C10
CR01
VR01
R01
C08
C09
L01
C04
L02
P01
C18
Q02
R68
Q03
CR06
C21
R10
R09
CR04
C25
CR05
R12
R11
CR02
CR03
R21
C27
C26
R20
U19
C28
C29
R22
R23
R17
R19
R14
R13
R18
R16
C22
C23
R15
C24
TP04
C56
L05
L06
C57
TP01
R44
C36
R43
P02
R45
C40
C38
R47
C39
C41
R46
C43
U20
R50
R51
R49
C42
R48
R52
C46
C44
R54
C45
C47
R53
R56
U21
R57
R58
C49
R55
C48
R59
C52
C51
R61
C50
R63
C53
R60
R62
U22
C55
C54
R64
R65
TP05
R66
R67
1
P1
11
(To A28XA6 via filtercon)
1
P2
4
TP2
F DIV
TP4
TP1
CL RTN
TP5


A6
COARSE
LOOP
DIVIDER

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6H-13. A6 Coarse Loop Divider PCB Parts Locator Diagram
6700-D-31706-3 (Rev. F)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
÷ 5/6 COUNTER
FRACTIONAL ÷ CONTROL
÷ 6 COUNTER
5/6 DIVIDER
A28 XA6
P1
CL DATA
CL CLK
+9VLP
+5VD
CL RTN
U1A
U1F
U1B
U1D
74HC14
U2
74HC164
U6
74HC164
U7
74167
U9
74LS283
U3
74S169
U8
74S169
U5A
74S74
U5B
74S74
SPARE
U10
MC12009
7805
VR1
CR1
1N4446
L1
47
L2
10
L3
10
R1
6.19
C8
10
C9
1
C10
10
C4
10
C1
0.1
C2
0.1
C3
0.1
C5
0.1
C6
0.1
C7
0.1
C11
0.1
C12
.001
C13
0.1
C14
.001
C15
0.1
C16
0.1
R2
51.1
R3
3.32K
R4
1.21K
R5
10
R6
82.5
R7
42.2
R8
1K
2N5179
Q1
4.8V
4V
J1
60-104 MHZ
≈-2dBm
(CL IF FROM)
(A3 J1)
+5V
+5VR
NC
2MHz
100nS
2 10A
F DIV

A6 COARSE LOOP DIVIDER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2 B3
3. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
4. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   CHASSIS GROUND:

   ISOLATED GROUND:
5. TEST POINTS ARE DENOTED AS: ②
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   CR3, Q1-Q5, U1
8. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C57	C17
CR6	C30-35
L6	C37
P2	L4
Q3	R24-42
R68	U11-15
TP5	
U22	
VR1	

Figure 6H-14. A6 Coarse Loop Divider PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31706-3 (Rev. F)

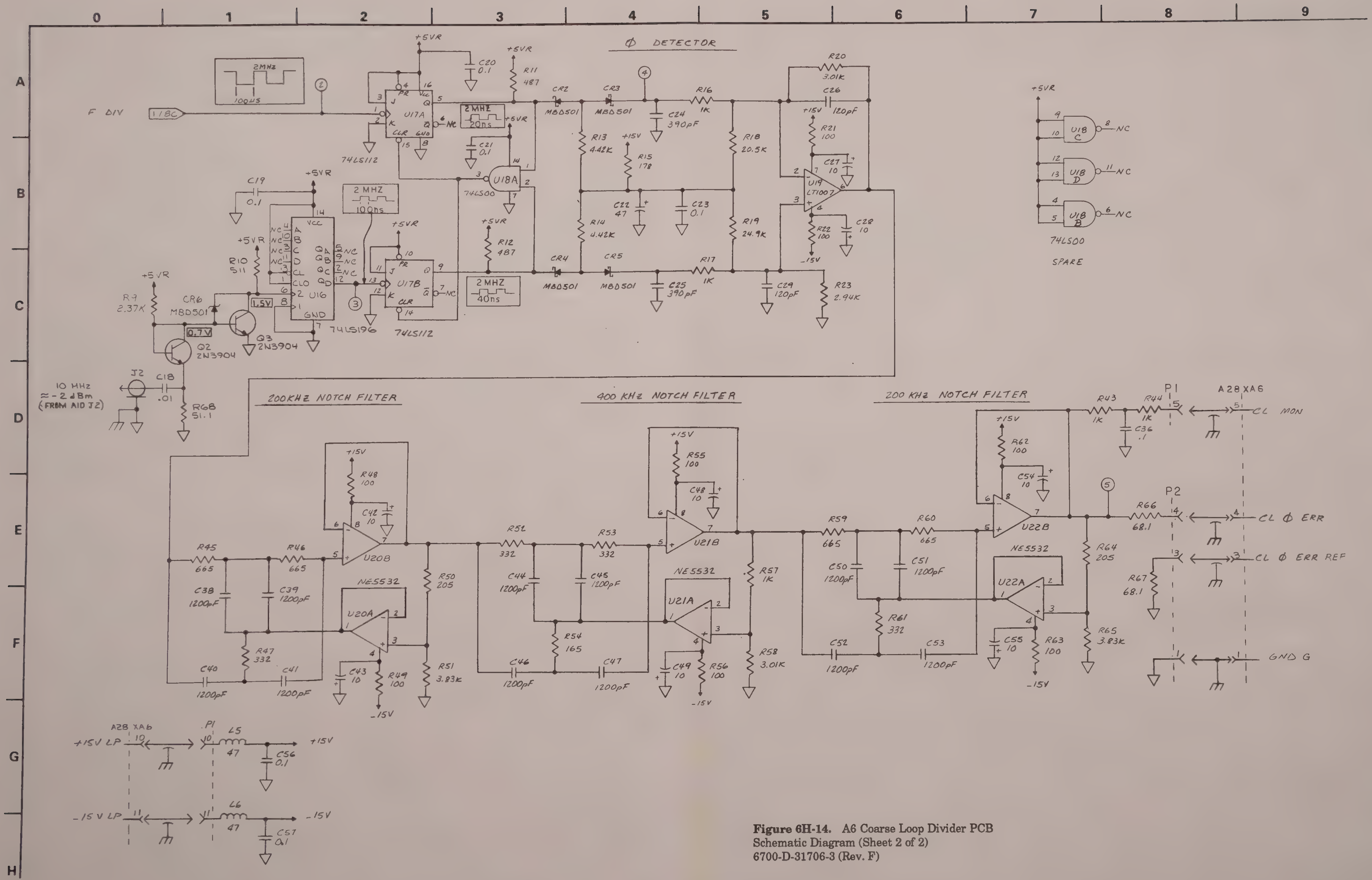

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
Φ DETECTOR
F DIV
1/8C
2MHz
100μS
U17A
74LS112
+5VR
C20 0.1
R11 487
CR2 MBD501
CR3 MBD501
C24 390pF
R16 1K
R20 3.01K
C26 120pF
2 MHZ 20ns
C21 0.1
U18A
74LS00
R13 4.42K
R15 178
R14 4.42K
C22 47
C23 0.1
R18 20.5K
R19 24.9K
+15V
R21 100
C27 10
U19 LT1007
R22 100
C28 10
-15V
C19 0.1
2 MHZ 100ns
U16
74LS196
U17B
74LS112
R12 487
2 MHZ 40ns
CR4 MBD501
CR5 MBD501
C25 390pF
R17 1K
C29 120pF
R23 2.94K
R10 511
R9 2.37K
CR6 MBD501
1.5V
0.7V
Q2 2N3904
Q3 2N3904
J2
C18 .01
R68 51.1
10 MHz ≈ -2 dBm (FROM A1D J2)
U18C
U18D
U18B
74LS00
SPARE
NC
200KHz NOTCH FILTER
400 KHz NOTCH FILTER
200 KHz NOTCH FILTER
R45 665
R46 665
C38 1200pF
C39 1200pF
R47 332
C40 1200pF
C41 1200pF
R48 100
C42 10
U20B
NE5532
U20A
C43 10
R49 100
R50 205
R51 3.83K
R52 332
R53 332
C44 1200pF
C45 1200pF
R54 165
C46 1200pF
C47 1200pF
R55 100
C48 10
U21B
NE5532
U21A
C49 10
R56 100
R57 1K
R58 3.01K
R59 665
R60 665
C50 1200pF
C51 1200pF
R61 332
C52 1200pF
C53 1200pF
R62 100
C54 10
U22B
NE5532
U22A
C55 10
R63 100
R64 205
R65 3.83K
R43 1K
R44 1K
C36 .1
P1
A28 XA6
CL MON
P2
R66 68.1
CL Φ ERR
R67 68.1
CL Φ ERR REF
GND G
+15V LP
L5 47
C56 0.1
+15V
-15 V LP
L6 47
C57 0.1
-15V

Figure 6H-14. A6 Coarse Loop Divider PCB Schematic Diagram (Sheet 2 of 2)
6700-D-31706-3 (Rev. F)

6I– FINE LOOP A9 AND A11 PCBs

6I-1 FINE LOOP ASSEMBLIES: A9 AND A11 PCBs

This section contains service information for the coarse loop assemblies listed in Table 6I-1 below. Refer also to the general reference information in Sections 6A, 6B, and 6C.

Table 6I-1. Fine Loop Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6I-2	6I-1
Block Diagram	Fig. 6I-2	6I-9
Troubleshooting	Tbl. 6I-2	6I-6
PCB LEVEL		
A9 Fine Loop Oscillator PCB		
Detailed Circuit Description	Para. 6I-3	6I-2
Troubleshooting	Tbl. 6I-2	6I-6
Parts Locator Diagram	Fig. 6I-3	6I-10
Schematic (Sheet 1 of 1)	Fig. 6I-4	6I-11
A11 Fine Loop Divider PCB		
Detailed Circuit Description	Para. 6I-4	6I-3
Troubleshooting	Tbl. 6I-2	6I-6
Parts Locator Diagram	Fig. 6I-5	6I-12
Schematic (Sheet 1 of 2)	Fig. 6I-6	6I-13
(Sheet 2 of 2)	Fig. 6I-6	6I-15

6I-2 FINE LOOP ASSEMBLIES, OVERALL DESCRIPTION

Refer to the block diagram in Figure 6I-2 for the following discussion.

The Fine Loop circuits provide the fine tuning frequencies for the YIG Loop circuits. The Fine Loop is comprised of the A9 Fine Loop Oscillator PCB and the A11 Fine Loop Divider PCB.

The primary circuit on the A9 Fine Loop Oscillator PCB is the 200-321 MHz voltage controlled oscillator (VCO). Its output is eventually divided and used as a reference signal on the A12 YIG Phase Detector PCB. The A9 PCB works in conjunction with the A11 Fine Loop Divider PCB; its circuits provide the necessary dividers and the phase/frequency detector circuit to accurately control the A9 PCB's VCO.

The A11 Fine Loop Divider PCB receives three signal inputs:

- A 10 MHz reference signal from the A10 Reference Buffer PCB,
- Serial data and clock signals from the A8 Serial I/O PCB, and
- The buffered output of the A9 Fine Loop 200-321 MHz VCO.

As indicated on the block diagram, the 10 MHz reference signal is divided by 100 and used as a reference signal for the 67XXA's switching power supply circuits. The serial data and clock signals from the A8 Serial I/O PCB originate in the A23 Microprocessor PCB. An appropriate divide number is programmed into the A11 PCB to arrive at a 100 kHz signal input to the Fine Loop phase/frequency detector. There, it is compared to the 100 kHz reference signal. An error correction signal is generated for tuning the A9 PCB's VCO. Notch filters eliminate any high frequency components.

The phase error signal is first amplified, then shaped to compensate for the nonlinear tuning characteristics of the oscillator's varactor diodes while maintaining loop bandwidth.

An external 10 MHz frequency synthesizer may be used in place of the 67XXA's internal crystal oscillator when finer frequency resolution is needed. The A9 PCB receives a TTL-level signal that disables the VCO to eliminate possible spurious responses from being generated.

6I-3 A9 FINE LOOP OSCILLATOR, DETAILED CIRCUIT DESCRIPTION

Refer to the A9 PCB schematic in Figure 6I-4 for the following discussion.

6I-3.1 Loop Amplifier

The phase error signal at A9P1-6 goes to U1A, a unity gain differential receiver. From U1-1, the error signal goes to loop amplifier U1B. Normally, when the J3 jumper is between pins 1 and 2, U1B has no dc feedback and the ac feedback is via C7 and C31. This provides a loop bandwidth of approximately 2 kHz. With the J3 jumper between pins 2 and 3, the amplifier becomes a unity gain inverting amplifier to allow testing of the oscillator without the phase lock loop. The output of U1-7 goes to the U3 shaping amplifier and to the R13 and R16 voltage divider. The A23 Microprocessor PCB and the A17 Analog Instruction PCB DVM circuit monitor the voltage from this divider for troubleshooting purposes.

NOTE

> Pressing **<Shift> TRIGGER 011** allows independent control of the Fine Loop VCO via the A11 Fine Loop Divider. The FREQUENCY display shows the frequency of the oscillator. the LEVEL display shows the tuning voltage.

6I-3.2 Linearizer

U2 and its associated circuits control the gain of the U3 amplifier by shaping the tuning voltage. Shaping compensates for the non-linear tuning characteristics of the varactor diodes. This allows a more constant loop gain and bandwidth with frequency.

U3 provides the tuning voltage to the CR11 and CR12 tuning varactors. U2A and U2B supply reference voltages for the CR5-CR10 shaping diodes. The resistors on the outputs of U2A and U2B determine the voltage of each diode's emitter. As the voltage on U3-3 goes above approximately 2V, CR10 starts conducting and puts R31 in the circuit. The gain of U3 then goes from a unity to a gain of approximately 1.25. As the input on U3 pin 3 reaches approximately 2.9V, CR9 starts conducting. This adds the parallel value of R26 and R27 in parallel with R31, which increases the gain of U3. This continues with each successive breakpoint until CR5 conducts. As CR5 conducts, the gain of U3 is at its maximum.

6I-3.3 Oscillator

Oscillator Q1 uses a low noise FET transistor. CR11 and CR12, in conjuction with the printed circuit transmission lines, form the resonant circuit for Q1. U4, the ALC amplifier, controls the collector current of Q1. Controlling the collector current controls the output power of the oscillator. The output of Q1 goes to the Q2 buffer amplifier, which reduces loading on the resonator circuit. This increases the Q (quality) of the oscillator, resulting in lower phase noise.

The output of Q2 goes to the two output buffer amplifiers and to CR14. CR14 is the rectifier diode for the ALC loop of the oscillator. As the output of Q2 increases, the voltage on the anode of CR14 goes more negative. This causes the output of U4 to go more positive, thereby reducing the conduction of Q1 and reducing its output power.

When an external source is used to get finer frequency resolution than is available with the 67XXA Fine Loop, the voltage at P1-4 goes to a TTL low. This causes the voltage on the emitter of CR1 to go negative, forcing the output of U4 to its maximum positive value and cutting off the Q1 oscillator. This reduces the possibility of spurious responses due to the mixing of the 67XXA Fine Loop and the external source in the A12 YIG Phase Detector.

6I-3.4 Output Amplifiers

The two output amplifiers isolate the output signals from each other and from the oscillator itself. Q3 provides some gain and Q4 provides a low output impedance. R43 provides the 50 Ohm output impedance for J1 while R59 does the same for J2. The Q5 and Q6 amplifiers operate in the same manner as Q3 and Q4.

6I-4 A11 FINE LOOP DIVIDER, DETAILED CIRCUIT DESCRIPTION

Refer to the A11 PCB schematic in Figure 6I-6 for the following discussion.

6I-4.1 10 MHz Input Circuit

Sheet 2 of the schematic set shows the 10 MHz Reference signal input at A11J2 which comes from A10J1. It goes to Q3 via Q2, which provides temperature compensation. Q3 converts the signal to TTL levels to drive U19, a dual bi-quinary divider. U19 divides the 10 MHz by 100 resulting in a 100 kHz TTL output for the U20 phase/frequency detector.

The 100 kHz signal also goes to U10 pins 9 and 10 where it is buffered and then sent to the A25 Switching Power Supply PCB. R10 and the capacitance on the chassis-mounted filtercon at P1 pin 7 provide filtering to improve EMI performance. The A25 Power Supply is injection locked to this signal to ensure that the frequency will not zero beat with the reference frequencies in the phase lock loops. This would cause spurious signals on the RF Output at a frequency offset from the carrier by the difference of the switching power supply frequency and the 100 kHz reference frequency.

6I-4.2 200-321 MHz Fine Loop Input

The 200-321 MHz signal at A11J1, shown on sheet 1 of the schematic set comes from A9J1. It goes to Q1 which is biased by R3 and R4 for a collector current of 10 mA and has a gain of about 5. From the collector of Q1, the signal goes to U14, and dual modulus divide-by-10/11. For the divide-by-11 to be enabled, both the PE1 and PE2 inputs must be in a low state; this is controlled by U13. R54, R55, R7, and R8 provide level shift of the TTL outputs of U13 to the ECL input levels required by U14. The TTL compatible output of U14-11 goes to inverter U15, then to counters U3, U8, and U12.

6I-4.3 Serial Input Circuits

The serial data from the A8 Serial I/O PCB goes to Schmitt trigger input TTL inverter U1 which improves transition times of the input. The signal goes to another inverter and then to U2, a shift register. U2-13 is connected to the input of U6, another shift register. **FL CLK** from the A8 PCB shifts the data input, which is 16 bits long, into the registers. The U1 Schmitt trigger buffers the clock signal.

Once data is shifted into the shift registers, the parallel outputs hold the data until new data is shifted in. The parallel data sets the count of the counters and fractional division control circuits.

FLD 12, also from the A8 PCB, is the only signal that is not sent serially for control of the A11 PCB. It is normally low and goes to a TTL high only at Fine Loop VCO frequencies of 300 MHz or greater.

6I-4.4 Counter Circuits

Decade counter U3 determines the count for the 10 MHz decade. U5 counts by either 2 or 3, depending on the condition of the **FLD 12** input control. U8 is the same as U5 except that it counts the pulses for the 1 MHz decade. U12 determines the number of output cycles of U14 when U14 is in the divide-by-11 state instead of the divide-by-10 state. U12 operates in both the 100 kHz decade steps and the 10 kHz fractional division steps. U7, in combination with U11, provides the counts for fractional division used to obtain the 10 kHz resolution of the Fine Loop.

Figure 6I-1 shows the control waveforms for modulus divider U14. The 100 kHz signal at U9 pin 5 goes to the phase/frequency detector to be compared with the divided 10 MHz reference frequency. This signal results from the signal at U4 pin 6. U9 provides 2 clock cycles of delay and determines the 100 ns pulse width for the signal at U9 pin 5. The signal at U9 pin 6, which is the inverted U9 pin 5 signal, reloads the counters for the next 100 kHz cycle.

The U9-6 signal also sets U13-5 low and U13-9 high. Also, it loads two counts into the U12 counter, which is programmed for this at 200 MHz. After two counts, U4 pin 12 changes states, causing U13 pin 5

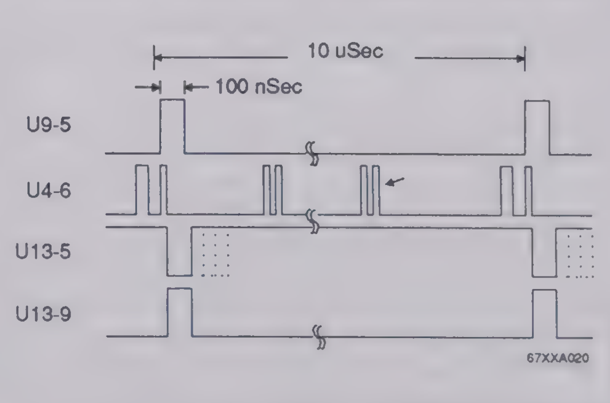


Figure 6I-1. U14 Modulus Divider Control Waveforms

to change back to a TTL high. This occurs at the same time that U13 pin 9 changes states, resulting in the U14 PE1 and PE2 signals being low at different times.

U11 is programmed for one higher than the required count of U12. When U11 pin 7 goes low, the output of U11 reprograms the U12 counter to provide an increase of one count. Another type of counter, the U7 rate multiplier, controls U11 pin 7. When U7 is programmed to provide one output pulse for every ten pulses at 100 kHz, it causes U11 to increase the count by one for every tenth 100 kHz pulse. This causes the output of U13 to stay low for one additional clock cycle from U14, and U14 to divide-by-11 for one output cycle. A 200 MHz division of 100 kHz requires 2000 input pulses to U14 or 20,000 pulses for 10 cycles at 100 kHz. This causes U14 to divide-by-11 for one out of every 10 cycles at 100 kHz, resulting in 20,001 input cycles for every 10 cycles. This results in a division of 2000.1 or 200.01 MHz at the input to U14. Increasing the count of U7 increments the 200 MHz signal in 10 kHz steps.

If U12 is programmed for a count of three instead of two, the output of U13 pin 5 causes U14 to divide-by-11 every 100 kHz cycle. This results in 2001 input cycles for each 100 kHz cycle. The Fine Loop frequency then equals 200.1 MHz. Increasing the U12 count to 4 results in 2002 input cycles going to U14 for each 100 kHz cycle. The Fine Loop frequency is then 200.2 MHz. By incrementing the count of U12, the entire 100 kHz decade can be obtained.

U7 can also be programmed for a count at the same time U12 is programmed to a higher count than two. When this occurs, for example at 200.11 MHz, U14 divides one out of every nine output cycles at 100 kHz by 11. It does the same for every two output cycles for each 100 kHz cycle. The dotted lines on the U13 pin 5 waveform in Figure 6I-1 show the effects of the waveform with each increasing count of U12.

At 200 MHz, U8 provides 20 output pulses for every 200 input pulses from U14. U3 provides two output pulses for every 20 input pulses from U8. U5 provides one output pulse for every two output pulses from U3. If U8 is programmed to load a count of one at every 100 kHz cycle, the input to U14 increases to 201 MHz to provide 100 kHz at U9-5. If U3 is programmed to load a count of one for each 100 kHz cycle, U8 must provide an additional 10 counts. This requires the input to U14 to increase to 210 MHz. By loading different counts into U3 and U8, the entire frequency range (from 200 to 300 MHz) can be covered in 1 MHz steps.

At 300 MHz, the **FLD 12** line goes to a TTL high. This causes U5 to output one pulse for every three input pulses which is essentially the 100 MHz decade. The *only* difference in the programming for the fine loop counters, at 200 and 300 MHz, is the **FLD 12** line. The input data to U3, U8, U12 and U7 is the same at 200 and 300 MHz. Incrementing in 10 kHz, 100 kHz, 1 MHz and 10 MHz steps is identical to when the frequency is at 200 MHz.

6I-4.5 Phase/Frequency Detector

Fine Loop phase/frequency detector U20 operates the same as the phase/frequency detectors on the A7 Reference Divider PCB and A6 Coarse Loop Divider PCB (See the A7 Reference Divider Circuit Description in section 6G for a detailed description).

U21 is configured as a differential receiver with a high input impedance on the two inputs to equalize the loading of the RC input filters. R20 provides a dc offset voltage for U21 which results in approximately three degrees of phase offset on the phase detector. This prevents the phase detector from operating in the dead zone and drastically affecting the loop dynamics. When the Fine Loop is phase locked, the loop amplifier forces the output of U21 to be 0V. This causes the output pulse on U20 pin 9 to be wider than at U20 pin 5, thereby canceling the offset provided by R20. R17 allows an ac signal to be injected for testing of the notch filters or for exercising the phase lock loop.

6I-4.6 Notch Filters

The A6 Coarse Loop circuit description in section 6H contains a detailed description of the operation of the active twin-T notch filter. Five notch filters on the A11 PCB reduce the fractional division sideband level. There are two each for 10 kHz since this is the highest amplitude and can cause the most spurious responses. There is one each for 20 kHz, 30 kHz and 40 kHz. These filters have a 40 dB (typical) rejection at their notch frequency.

The output of U26 contains the phase error information and goes to the A9 Fine Loop Oscillator PCB to correct the VCO frequency. It also goes to R46, C48, and R47 which provide filtering and isolation and to the A17 Analog Instruction PCB DVM circuit. The A23 Microprocessor monitors this signal via the A17 PCB's DVM to determine if the Fine Loop is phase locked. When the Fine Loop is phase locked, this voltage is very close to 0V.

6I-5 FINE LOOP ASSEMBLIES, TROUBLESHOOTING

Troubleshooting procedures in Table 6I-2 cover the A9 Fine Loop Oscillator PCB and the A11 Fine Loop Divider PCB.

6I-6 FINE LOOP ASSEMBLIES, SERVICE SHEETS

Table 6I-1 on the first page of this section presents the arrangements of the block diagrams, schematics, and parts locater diagrams for the A9 and A11 PCBs.

Table 6I-2. Fine Loop Troubleshooting (1 of 3)

Trouble / Error Code	Troubleshooting Procedure
	A9 Fine Loop Oscillator PCB Troubleshooting
Manual VCO Tuning	Disconnect the A6J2 cable and connect a spectrum analyzer or power meter to A6J2. Press <Shift> TRIGGER 011. You may now tune the frequency of the A9 Fine Loop oscillator via the front panel. It will tune from 200 MHz to 321 MHz in as little as 10 kHz steps. The power output should be –5 dBm +/–2 dB.
Phase Noise and Fractional Division Sidebands	Observing the signal on a spectrum analyzer, you can easily measure the phase noise. Typically, it is greater than –78 dBc. Measure in a 100 Hz bandwidth, 1 kHz away from the carrier. You should get about –60 dBc. Resolving this to a 1 Hz bandwidth results in a measurement of –80 dBc. (Take into account the shape factor of the IF filter of the spectrum analyzer. For example, in the Tektronics 494, reduce the measured value by 2 dB. This results in a reading of –78 dBc in a 1 Hz BW.) Since this frequency is divided by 10 in the A12 YIG Phase Detector PCB, the –98 dBc phase noise resulting from the Fine Loop does not have an appreciable effect on the main RF output signal. Setting a frequency that requires fractional division, for example 200.01 MHz, displays the fractional division sidebands and the reference frequency sideband (100 kHz) on the spectrum analyzer. They should be within the following specifications: • 10 kHz –49 dBc (fractional division) • 20 kHz –45 dBc (fractional division) • 30 kHz –45 dBc (fractional division) • 40 kHz –42 dBc (fractional division) • 50 kHz –39 dBc (fractional division and switching power supply) • 100 kHz –10 dBc (reference frequency and switching power supply). If the fractional division sidebands are out of spec, it indicates a defective notch filter on the A11 Fine Loop divider board. If the 50 kHz and 100 kHz sidebands are out of spec, it indicates that either the loop amplifier has too wide a bandwidth or there is a defective decoupling network on either the A9 or A11 PCBs. The 20 dB, in the division process of the A12 YIG Phase Detector PCB, decreases these sidebands. The A16 FM PCB also has 50 kHz and 100 kHz notch filters to reduce the 50 kHz and 100 kHz from the switching power supply and the A9 Fine Loop Oscillator. The signal, at approximately 3 kHz from the 50 kHz or 100 kHz sideband, indicates that the A25 Switching Power Supply is not injection locked to the A11 Fine Loop Divider. To check the A6J1 buffer circuit, interchange the A6J1 and A6J2 connections. Removing the A6J1 output cable, which goes to the A11 Fine Loop Divider, causes the Fine Loop Oscillator to go to its upper limit, which should be greater than 330 MHz.
Linearizer (Tuning Shaper)	Check the following voltages with a DVM • U2 pin 1 = 5.5V • U2 pin 7 = 1.2V If these voltages are not correct, either CR4 or U2 are defective. If these voltages are correct, compare the voltages on the cathodes of diodes CR5-CR10 with the voltage values on the A9 PCBschematic. An incncorrect voltage indicates a defective diode or resistor network.

Table 6I-2. Fine Loop Troubleshooting (2 of 3)

Trouble / Error Code	Troubleshooting Procedure
	A9 Fine Loop Oscillator PCB Troubleshooting (Continued)
E9-10	This test checks the A11 PCB's phase detector output voltage. If the A9 Fine Loop Oscillator is locked, it then checks to see if calibration is required. If the A9 is not phase locked, the A23 Microprocessor performs the E9-11 through E9-13 tests to further localize failure. The E9-10 error code indicates the processor was not able to localize the failure mode by using the E9-11 through E9-13 code tests. This indicates a failure in either the A9 or A11 PCB. To troubleshoot: • Perform E9-12 troubleshooting tests. • Perform E9-11 troubleshooting tests.
E9-11	If the error voltage is positive, the most likely cause is a failure in the 200-321 MHz output of the A9 PCB or the A11 Fine Loop phase/frequency detector. • Disconnect A9J1. • Connect a spectrum analyzer to A9J2. The signal frequency should be >330 MHz and <380 MHz at –7 dBm. If this is not the case, go to the previous A9 PCB troubleshooting hints.
E9-12	The A23 Microprocessor has determined that the Coarse Loop is not phase locked. It checks if the error voltage is negative. If the error voltage is negative, the most likely cause is a failure in the 10 MHz reference signal supplied by the A10 Reference Buffer PCB. • Connect a spectrum analyzer to A10J1. The spectrum analyzer should indicate a 10 MHz signal of approximately 0 dBm. • If there is no 10 MHz signal, go to the A10 PCB troubleshooting in section 6G. If there is a 10 MHz signal, reconnect A11J1 cable to A10J1, and go to the following A11 PCB troubleshooting hints.
E9-13	This error indicates a failure in the tuning voltage circuit for the A9 Fine Loop Oscillator. Go to A9 PCB Linearizer (Tuning Shaper) troubleshooting hints.
	A11 Fine Loop Divider PCB Troubleshooting
	Troubleshooting the A11 Fine Loop Divider PCB is almost the same as troubleshooting the A6 Coarse Loop Divider PCB (in section 6H), since both boards perform the same type of functions. For example, an external signal source can be used in place of the A9 Fine Loop Oscillator. This sometimes makes it easier to observe the waveforms in the divider circuits.
Fractional Division Sidebands	If the fractional division sidebands are out of specification on the A9 Fine Loop Oscillator, one of the notch filters is probably defective. If the 40 kHz sideband is out of spec, the 40 kHz notch filter is defective. If the 10 kHz sideband is out of specification, either one of the 10 KHz notch filters is defective. One way to check this is to inject a signal at TP4 with an audio oscillator. Adjust the frequency around the notch frequency while observing the output of the filter with an oscilloscope. Typical rejection should be about 40 dB at the notch frequency. For more sensitivity, use a spectrum analyzer with a scope probe and observe the outputs of the filter. Be sure, however, that the spectrum analyzer can handle any dc voltage that the probe might come in contact with. If the spectrum analyzer cannot handle all dc voltages, or it loads down the circuit under test, put a 0.1 uf capacitor in series with the scope probe.

Table 6I-2. Fine Loop Troubleshooting (3 of 3)

Trouble / Error Code	Troubleshooting Procedure
	A11 Fine Loop Divider PCB Troubleshooting (Continued)
Fractional Division Sidebands (continued)	The usual cause of a defective notch filter is a change in value of one of the resistors or capacitors in the twin-T network on each filter. If the amplifier that provides the feedback to the center of the twin-T filter is defective, it can degrade the sharpness of the notch and the rejection. If the notch filter is not sharp enough, it can cause loop oscillations or peaking of the noise sidebands on the A9 Fine Loop Oscillator. The HP 3585 spectrum analyzer, or its equivalent, is very useful for checking the notch filters since it has a tracking generator. A scope probe can be used with it and the tracking generator can go into TP4. This will give a dynamic range of approximately 100 dB and show the filter characteristics the same way a WILTRON 560 Network Analyzer and 6600 Sweeper does. Under phase lock conditions, the outputs of U21 thru U26 should be 0V. Usually, if one of the amplifiers in this chain is defective, the A9 Fine Loop Oscillator will not lock. To check this, connect pins 3 and 5 together on U21. This forces the output of U21 to a slightly negative voltage, due to R20. This voltage should be the same at the output of each notch filter. On the output of the feedback amp in the filter, this voltage should be about 5% lower due to the divider action of the input resistors. Signal tracing the 10 MHz input with a scope is the simplest way to check the 10 MHz input circuit. U19-7 should have a 1 MHz pulse and U19-13 should have a 100 kHz pulse with a 10 MHz input on J2.
200-321 MHz Input	Troubleshooting the 200-321 MHz input at J1 is more difficult due to the bandwidth of most oscilloscopes. However, U14-11 is in the frequency range of most oscilloscopes. Use an external signal source for input. The output frequency of U14 should be 1/10th of the external source frequency. Check the dc voltages of Q1 collector and base to determine if it is correct. If these voltages are correct but there is no output from U14, it is defective.
Count Errors	If the 1 MHz decade step of the counter is defective, it will give either a false count or no count. With no output, the counter will not lock. Check the output frequency of U8-12 against its input frequency. A false count appears as a 1 MHz step being off frequency by 1 MHz. For example, 201 MHz indicates 202 MHz. The same is true of the U3 10 MHz counter. If the frequency requested is off by an even 10 MHz or a similar increment, it indicates that either U3 or the shift register that's programming the data input is defective. U5 always has a one count output for two or three input pulses, depending on the state of the **FLD 12** control line. This is very easy to check with a scope. U7 is used only for the 10 kHz steps. If you synchronize the scope on the 100 kHz signal at TP3 and increment the frequency in 10 kHz increments from 10 kHz to 90 kHz, you should see an additional pulse for each 100 kHz pulse train as the frequency is incremented. To check U11 and U12, syncronize the scope on U13-9 and observe the waveform at U13 pin 5. You should see the pulse there increase in 50 ns increments with each increase in a 100 kHz step.

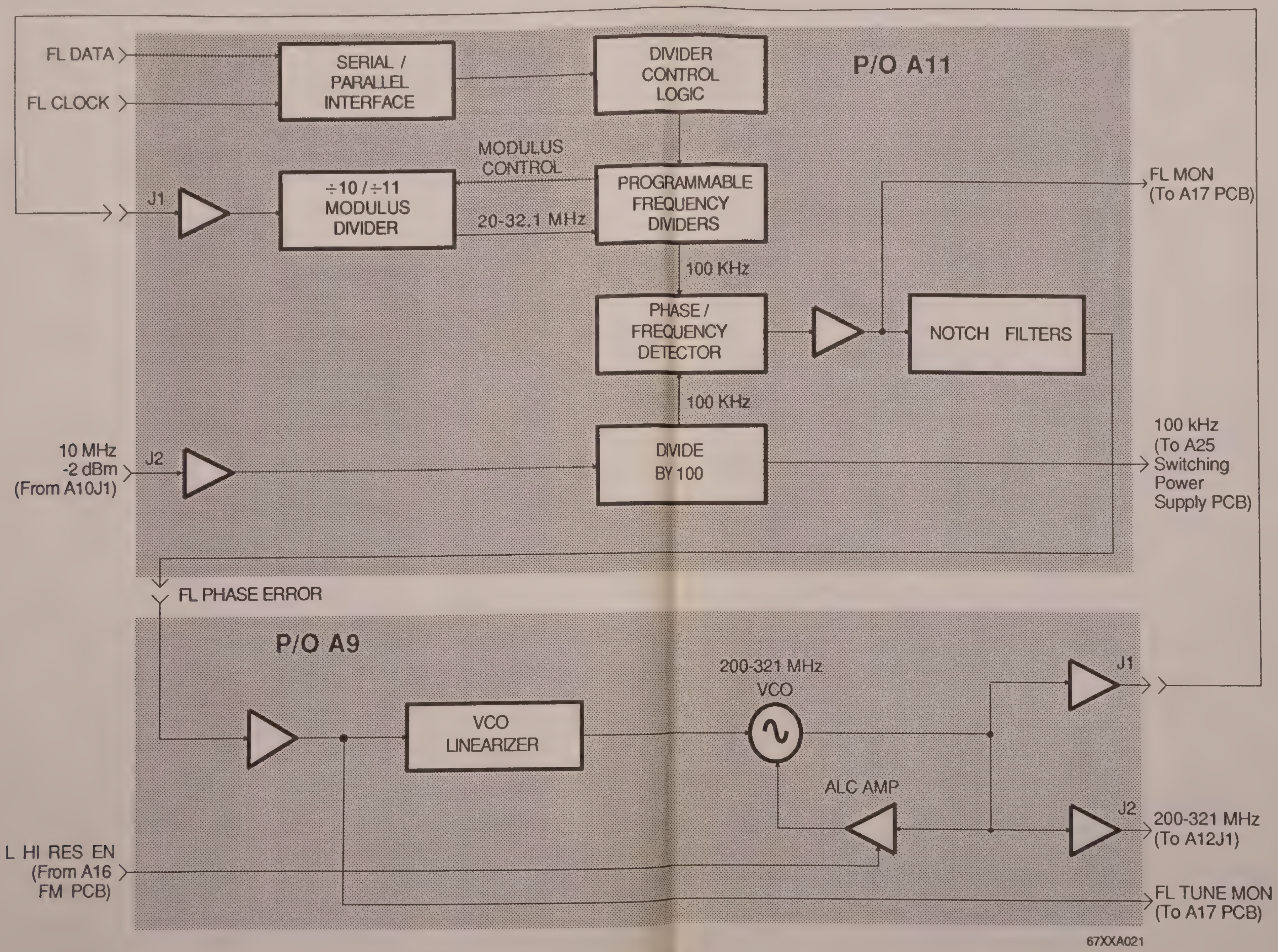
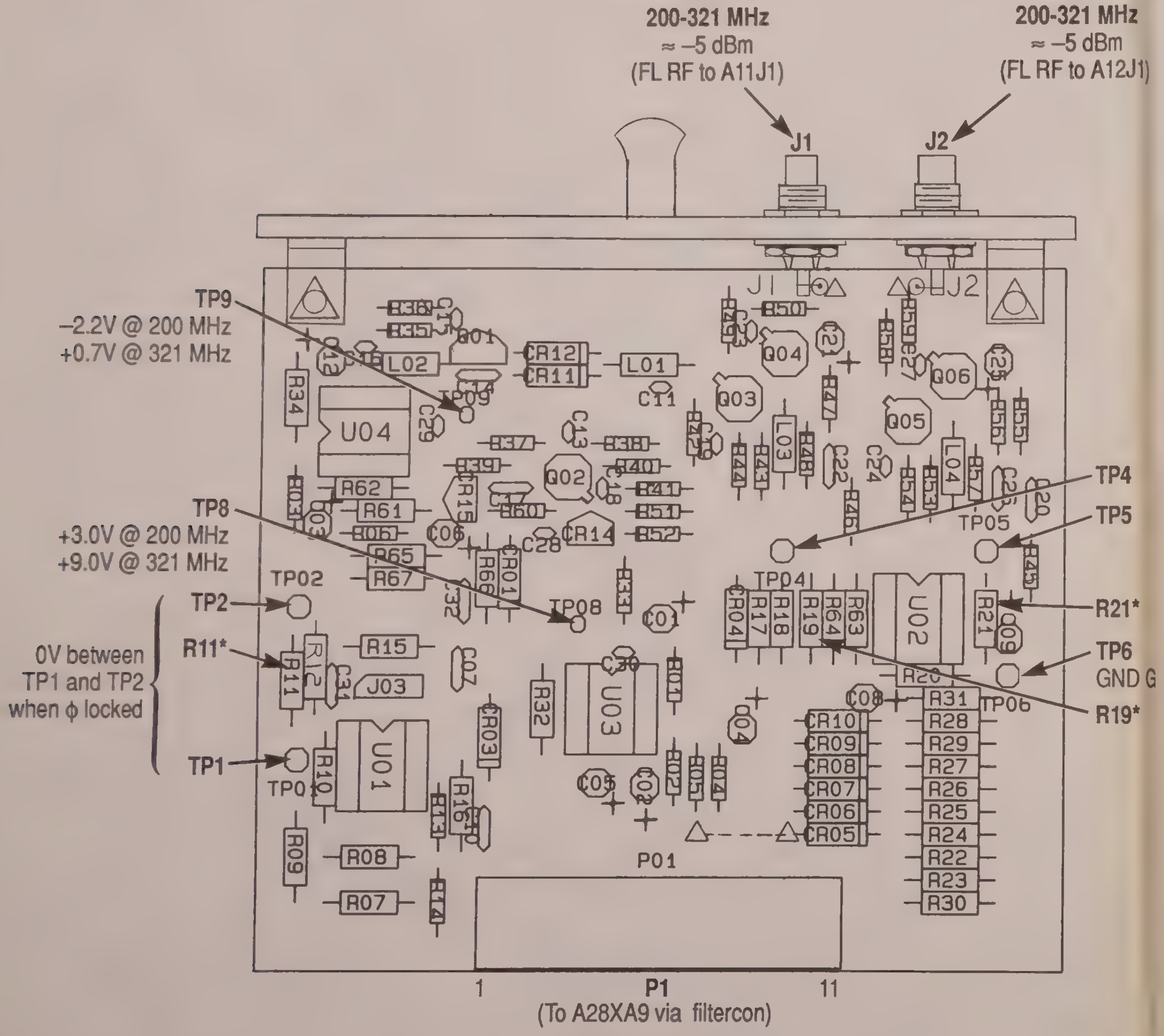

P/O A11
FL DATA
FL CLOCK
SERIAL / PARALLEL INTERFACE
DIVIDER CONTROL LOGIC
MODULUS CONTROL
J1
÷10 / ÷11 MODULUS DIVIDER
20-32.1 MHz
PROGRAMMABLE FREQUENCY DIVIDERS
100 KHz
FL MON (To A17 PCB)
PHASE / FREQUENCY DETECTOR
NOTCH FILTERS
100 KHz
10 MHz -2 dBm (From A10J1)
J2
DIVIDE BY 100
100 kHz (To A25 Switching Power Supply PCB)
FL PHASE ERROR
P/O A9
200-321 MHz VCO
VCO LINEARIZER
J1
ALC AMP
J2
200-321 MHz (To A12J1)
L HI RES EN (From A16 FM PCB)
FL TUNE MON (To A17 PCB)
67XXA021

Figure 6I-2. Fine Loop Block Diagram


200-321 MHz
≈ –5 dBm
(FL RF to A11J1)
200-321 MHz
≈ –5 dBm
(FL RF to A12J1)
J1
J2
TP9
–2.2V @ 200 MHz
+0.7V @ 321 MHz
TP8
+3.0V @ 200 MHz
+9.0V @ 321 MHz
TP2
R11*
0V between
TP1 and TP2
when ϕ locked
TP1
TP4
TP5
R21*
TP6
GND
R19*
U01
U02
U03
U04
Q01
Q02
Q03
Q04
Q05
Q06
L01
L02
L03
L04
J03
P01
1
P1
11
(To A28XA9 via filtercon)

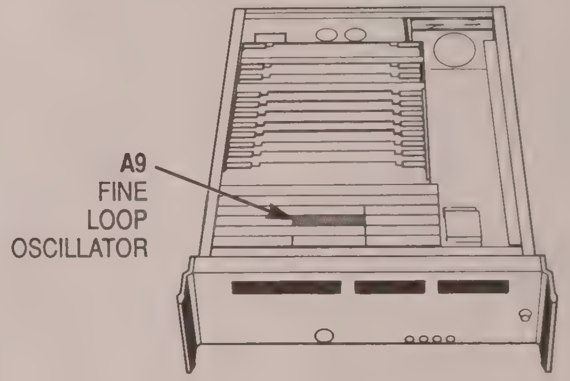
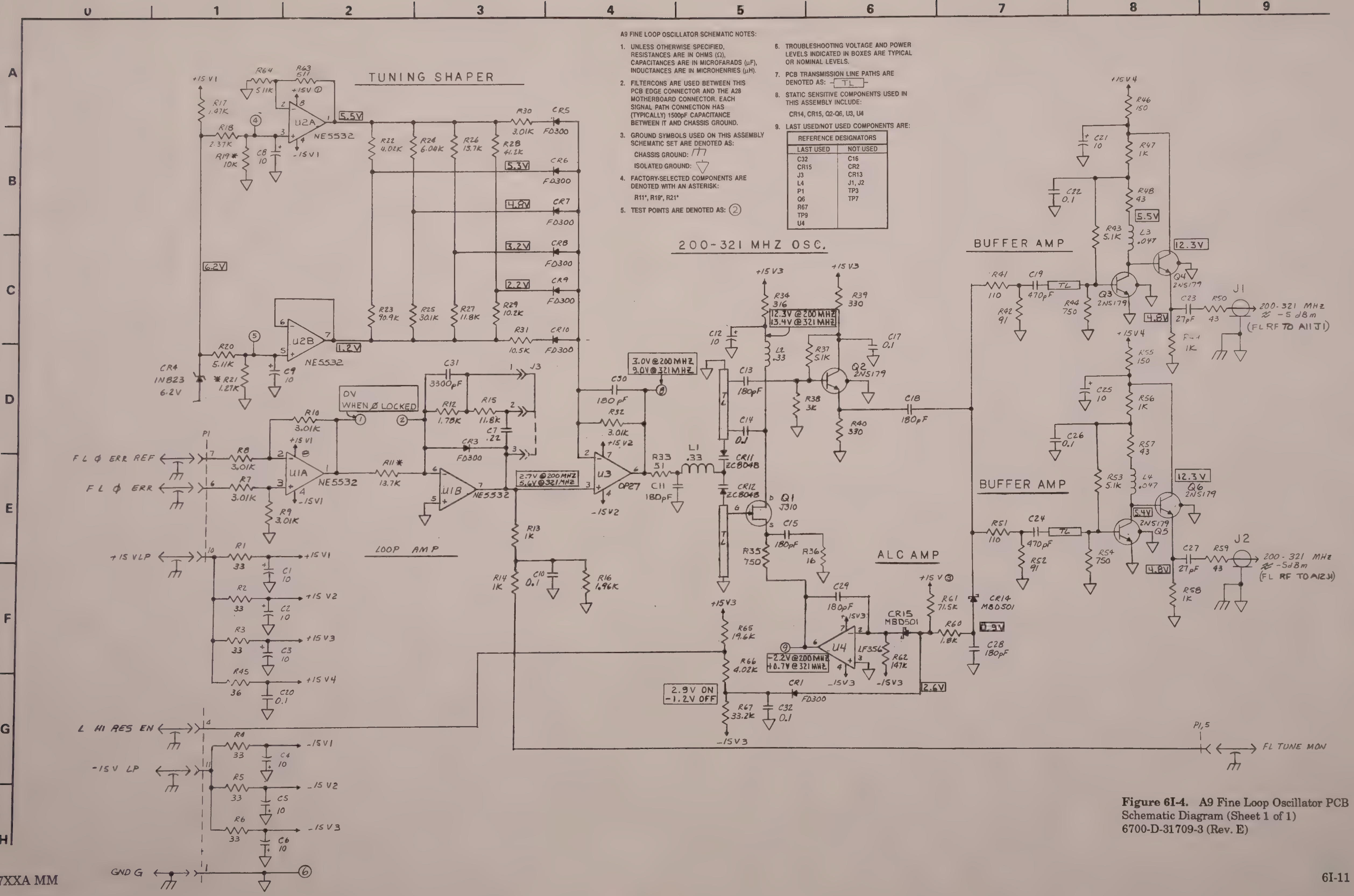

A9
FINE
LOOP
OSCILLATOR

Figure 6I-3. A9 Fine Loop Oscillator PCB Parts Locater Diagram
6700-D-31709-3 (Rev. E)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
TUNING SHAPER
200-321 MHZ OSC.
BUFFER AMP
BUFFER AMP
ALC AMP
LOOP AMP
+15 V1
R64 511K
R63 511
+15V ①
U2A NE5532
-15 V1
5.5V
R17 1.47K
R18 2.37K
R19* 10K
C8 10
R22 4.02K
R24 6.04K
R26 13.7K
R28 41.2K
R30 3.01K
CR5 FD300
CR6 FD300
5.3V
CR7 FD300
4.8V
CR8 FD300
3.2V
CR9 FD300
2.2V
CR10 FD300
6.2V
R23 90.9K
R25 30.1K
R27 11.8K
R29 10.2K
R31 10.5K
U2B NE5532
1.2V
R20 5.11K
C9 10
CR4 1N823 6.2V
R21* 1.27K
C31 3300pF
J3
R12 1.78K
R15 11.8K
C7 .22
CR3 FD300
0V WHEN Ø LOCKED
R10 3.01K
+15 V1
U1A NE5532
-15 V1
R11* 13.7K
U1B NE5532
FL Ø ERR REF
FL Ø ERR
P1
R8 3.01K
R7 3.01K
R9 3.01K
2.7V @ 200 MHZ
5.6V @ 321 MHZ
C30 180pF
R32 3.01K
+15 V2
U3 OP27
-15 V2
3.0V @ 200 MHZ
9.0V @ 321 MHZ
R33 51
C11 180pF
L1 .33
R13 1K
R14 1K
C10 0.1
R16 1.96K
+15 V3
R34 316
12.3V @ 200 MHZ
13.4V @ 321 MHZ
R39 330
C12 10
L2 .33
C13 180pF
C14 0.1
R37 5.1K
C17 0.1
Q2 2N5179
R38 3K
R40 330
C18 180pF
CR11 ZC804B
CR12 ZC804B
Q1 J310
C15 180pF
R35 750
R36 16
+15 V4
R46 150
C21 10
R47 1K
C22 0.1
R48 43
5.5V
R43 5.1K
L3 .047
12.3V
Q4 2N5179
R41 110
C19 470pF
TL
R42 91
R44 750
Q3 2N5179
4.8V
C23 27pF
R50 43
J1
200-321 MHz ≈ -5 dBm
(FL RF TO A11 J1)
R49 1K
R55 150
C25 10
R56 1K
C26 0.1
R57 43
R53 5.1K
L4 .047
12.3V
Q6 2N5179
5.4V
Q5 2N5179
R51 110
C24 470pF
R52 91
R54 750
C27 27pF
R59 43
J2
200-321 MHz ≈ -5dBm
(FL RF TO A12 J1)
R58 1K
+15 V ③
R61 71.5K
CR14 MBD501
CR15 MBD501
R60 1.8K
0.9V
C28 180pF
C29 180pF
U4 LF356
R62 147K
-2.2V @ 200 MHZ
+0.7V @ 321 MHZ
-15 V3
2.6V
R65 19.6K
R66 4.02K
2.9V ON
-1.2V OFF
CR1 FD300
R67 33.2K
C32 0.1
-15 V3
+15 VLP
R1 33
C1 10
+15 V1
R2 33
C2 10
+15 V2
R3 33
C3 10
+15 V3
R45 36
C20 0.1
+15 V4
L HI RES EN
-15 V LP
R4 33
C4 10
-15 V1
R5 33
C5 10
-15 V2
R6 33
C6 10
-15 V3
GND G
⑥
P1,5
FL TUNE MON

A9 FINE LOOP OSCILLATOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   CHASSIS GROUND:

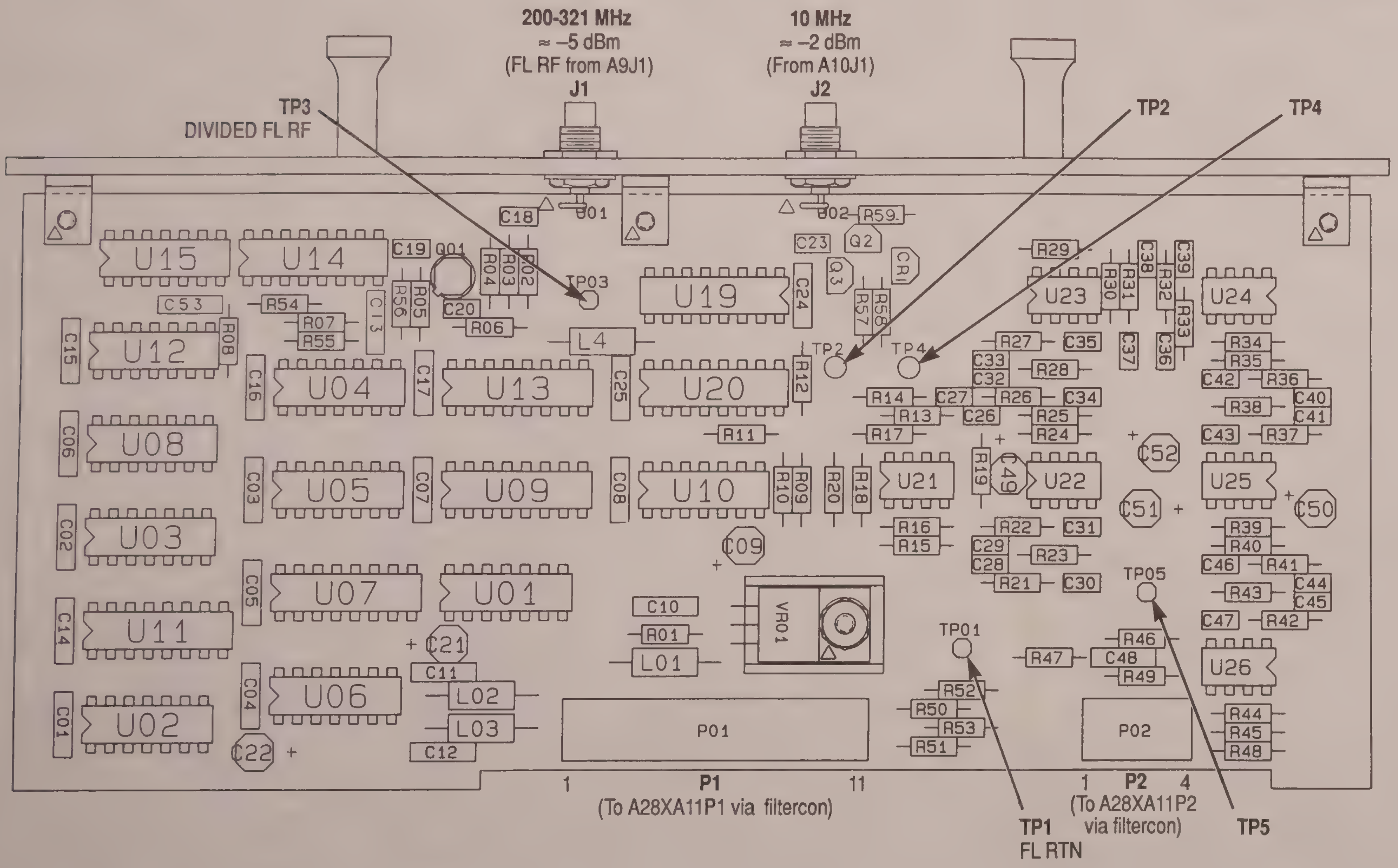
   ISOLATED GROUND:
4. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK:

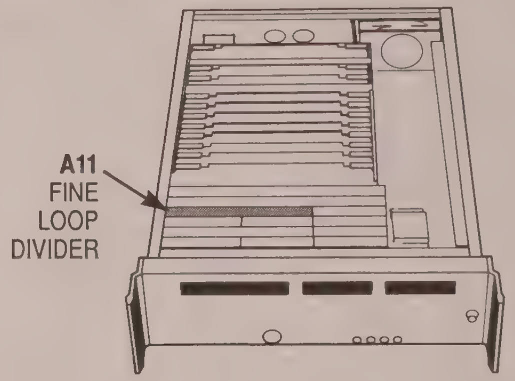
   R11*, R19*, R21*
5. TEST POINTS ARE DENOTED AS: ②
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. PCB TRANSMISSION LINE PATHS ARE DENOTED AS: -[TL]-
8. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   CR14, CR15, Q2-Q6, U3, U4
9. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C32	C16
CR15	CR2
J3	CR13
L4	J1, J2
P1	TP3
Q6	TP7
R67	
TP9	
U4	

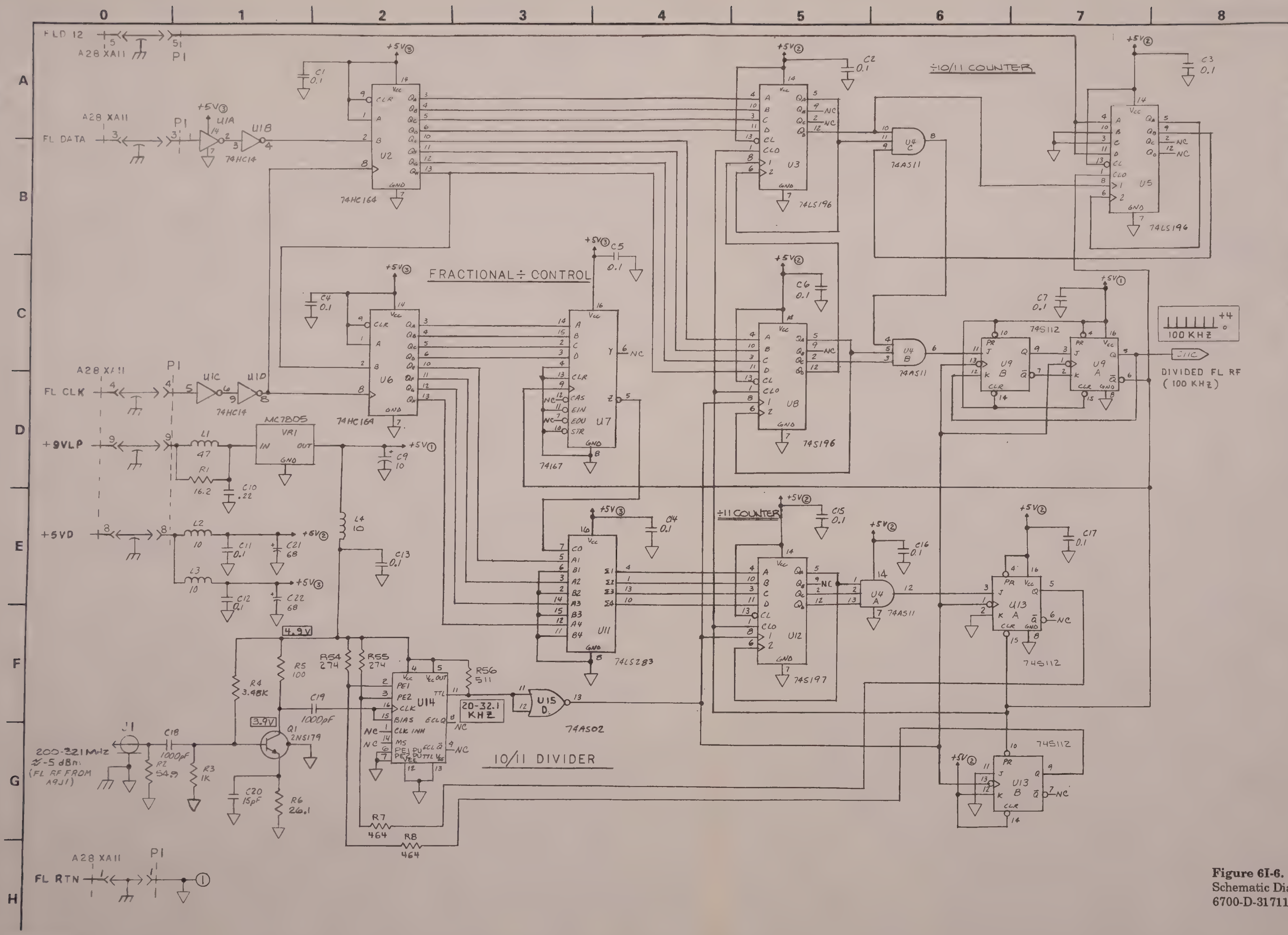
Figure 6I-4. A9 Fine Loop Oscillator PCB Schematic Diagram (Sheet 1 of 1)
6700-D-31709-3 (Rev. E)


200-321 MHz
≈ −5 dBm
(FL RF from A9J1)
J1
10 MHz
≈ −2 dBm
(From A10J1)
J2
TP3
DIVIDED FL RF
TP2
TP4
P1
(To A28XA11P1 via filtercon)
P2
(To A28XA11P2 via filtercon)
TP1
FL RTN
TP5


A11
FINE
LOOP
DIVIDER

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6I-5. A11 Fine Loop Divider PCB Parts Locater Diagram
6700-D-31711-3 (Rev. F)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
FLD 12
A28 XA11
P1
FL DATA
FL CLK
+9VLP
+5VD
FL RTN
+5V③
+5V②
+5V①
U1A
U1B
U1C
U1D
74HC14
U2
74HC164
U6
74HC164
FRACTIONAL ÷ CONTROL
U7
74167
U3
74LS196
U5
74LS196
÷10/11 COUNTER
U4 C
74AS11
U8
74S196
U4 B
74AS11
U9 B
U9 A
74S112
100 KHZ
+4
0
2/1C
DIVIDED FL RF
(100 KHZ)
MC7805
VR1
L1 47
R1 16.2
C10 .22
L2 10
L3 10
L4 10
C21 68
C22 68
C9 10
÷11 COUNTER
U11
74LS283
U12
74S197
U4 A
74AS11
U13 A
74S112
U13 B
74S112
4.9V
R4 3.48K
R5 100
R54 274
R55 274
R56 511
U14
20-32.1 KHZ
U15 D
74AS02
10/11 DIVIDER
J1
C18 1000pF
C19 1000pF
C20 15pF
Q1 2N5179
3.9V
R2 54.9
R3 1K
R6 26.1
R7 464
R8 464
200-321 MHz
≈-5 dBm
(FL RF FROM A9J1)

A11 FINE LOOP DIVIDER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
4. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

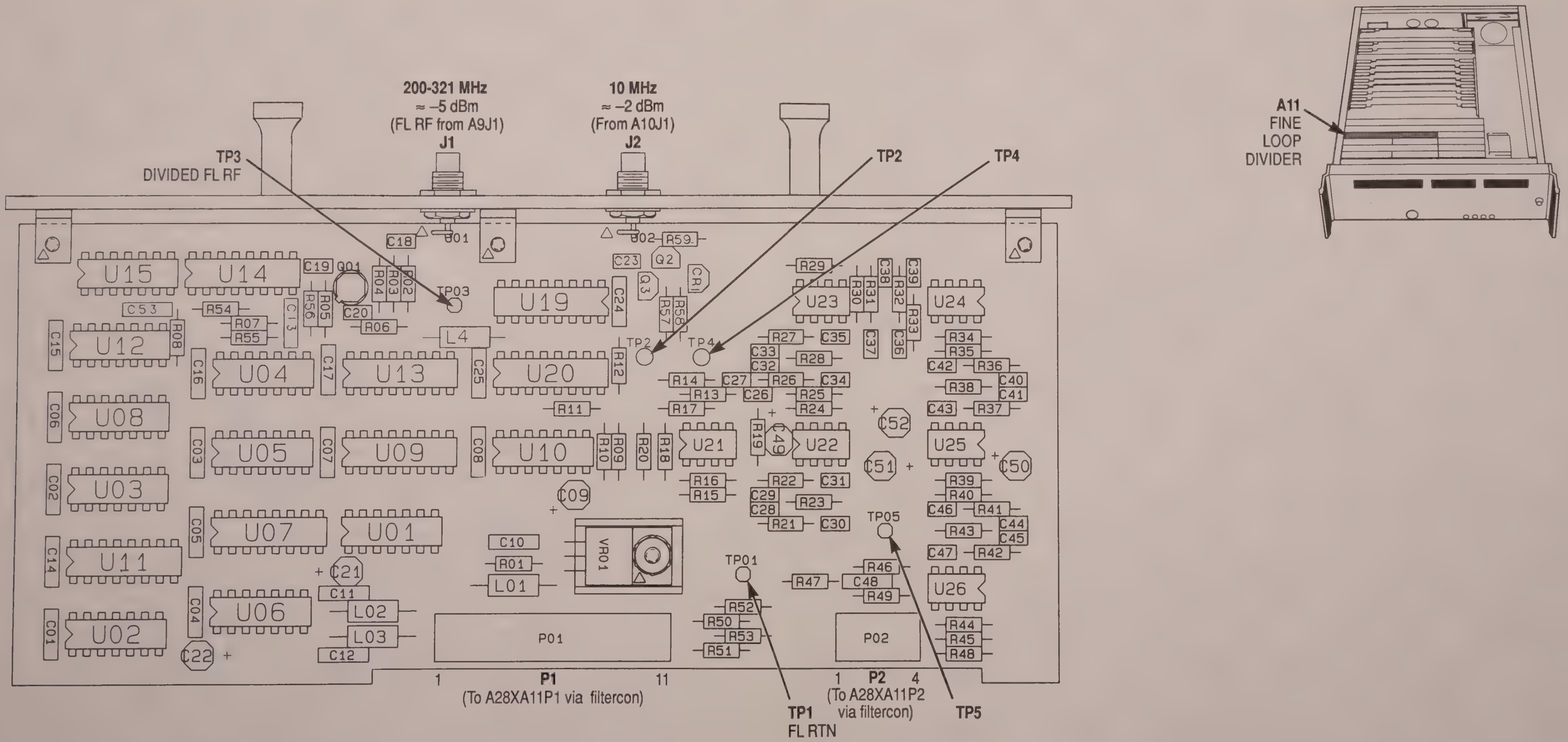
   CHASSIS GROUND:

   ISOLATED GROUNDS: ▽
5. TEST POINTS ARE DENOTED AS: ②
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   CR1, Q1, U3, U5, U7-U13, U19, VR1
8. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C53	U16-18
CR1	
L4	
P2	
Q3	
R59	
TP5	
U26	
VR1	

Figure 6I-6. A11 Fine Loop Divider PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31711-3 (Rev. G)


200-321 MHz
≈ –5 dBm
(FL RF from A9J1)
J1
10 MHz
≈ –2 dBm
(From A10J1)
J2
TP3
DIVIDED FL RF
TP2
TP4
A11
FINE
LOOP
DIVIDER
U15
U14
C19
Q01
R04
R03
R02
C18
U01
C53
R54
R07
R55
C13
R56
R05
C20
R06
TP03
U19
C24
C23
Q2
U02
R59
CR1
Q3
R57
R58
C15
U12
R08
L4
C16
U04
C17
U13
C25
U20
R12
TP2
TP4
R11
C06
U08
C03
U05
C07
U09
C08
U10
R10
R09
R20
R18
C02
U03
C09
C05
U07
U01
VR01
C10
R01
L01
C14
U11
C21
C11
L02
L03
C12
C04
U06
C01
U02
C22
P01
R29
C38
C39
U23
R30
R31
R32
R33
U24
R27
C35
C37
C36
R34
R35
C33
C32
R28
C42
R36
R14
C27
R26
C34
C40
R13
C26
R25
R38
C41
R17
R24
C43
R37
R19
C49
U21
U22
C52
U25
C51
C50
R16
R15
R22
C31
R39
R40
C29
C28
R23
C46
R41
R21
C30
TP05
R43
C44
C45
C47
R42
TP01
R46
R47
C48
R49
U26
R52
R50
R53
R51
P02
R44
R45
R48
1
P1
11
(To A28XA11P1 via filtercon)
1
P2
4
(To A28XA11P2
via filtercon)
TP1
FL RTN
TP5

NOTE:
Leading zeros on
component number
references may be
disregarded.

Copy of Figure 6I-5. A11 Fine Loop Divider PCB Parts Locater Diagram
6700-D-31711-3 (Rev. F)

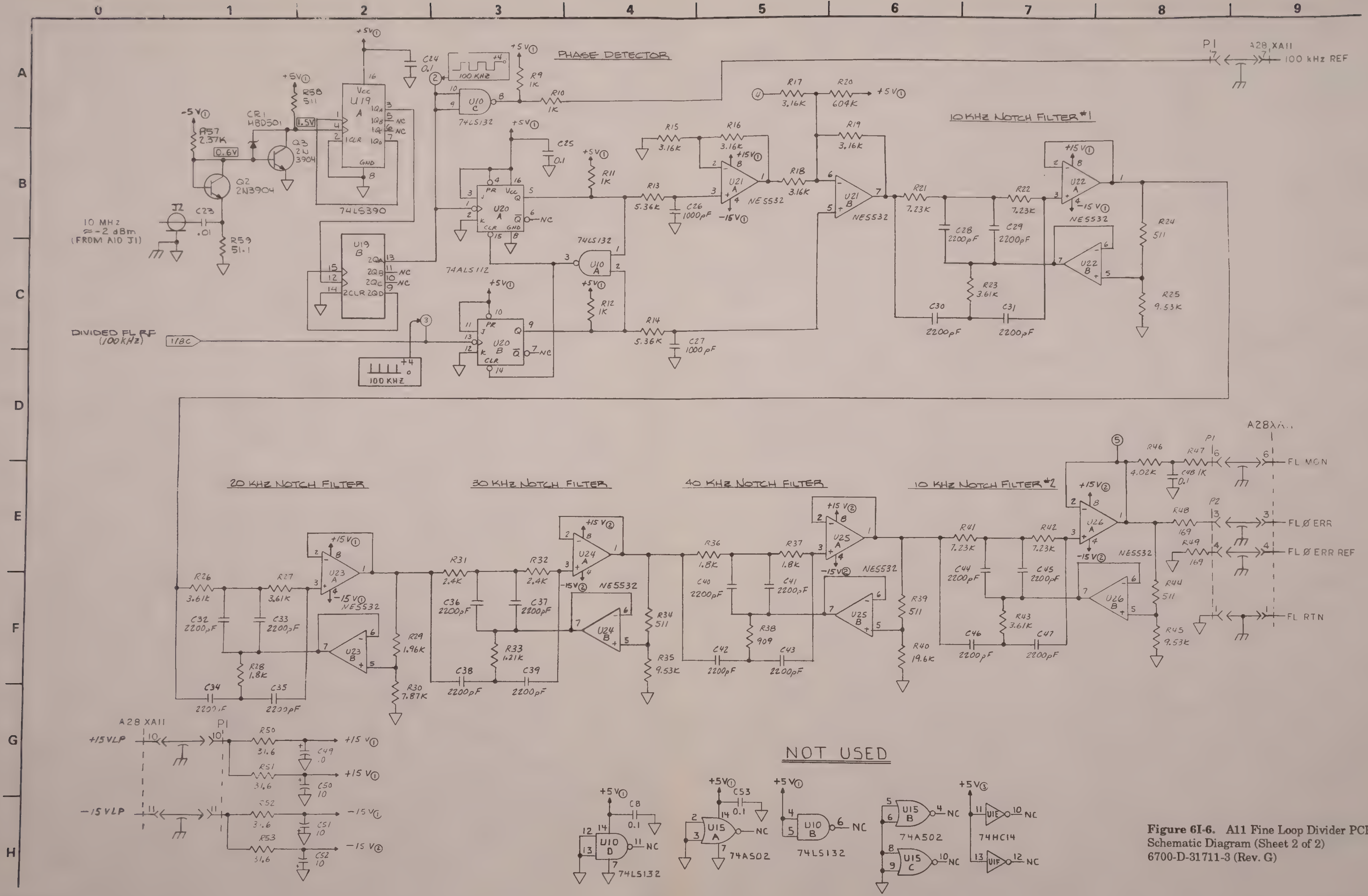

PHASE DETECTOR
10 KHz NOTCH FILTER #1
20 KHz NOTCH FILTER
30 KHz NOTCH FILTER
40 KHz NOTCH FILTER
10 KHz NOTCH FILTER #2
NOT USED
10 MHz ≈ -2 dBm (FROM A10 J1)
DIVIDED FL RF (100 kHz)
100 kHz REF
FL MON
FL Ø ERR
FL Ø ERR REF
FL RTN
+15 VLP
-15 VLP
A28 XA11
P1
P2
J2
U19 A 74LS390
U20 A 74ALS112
U10 C 74LS132
U21 A NE5532
U22 A NE5532
U23 A NE5532
U24 A NE5532
U25 A NE5532
U26 A NE5532
Q2 2N3904
Q3 2N3904
CR1 HBD501
0.6V
1.5V
100 KHZ
74A502
74HC14
74LS132

Figure 6I-6. A11 Fine Loop Divider PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31711-3 (Rev. G)

6J–YIG LOOP/ FM MODULATION SUBSYSTEM: A12 AND A16 PCBs

6J-1 INTRODUCTION

This section contains service information for the YIG Loop and FM Modulation circuits located on the A12 and A16 PCBs and also on the A30 Sampler/IF Amp Assembly and the A31 Multiplier/Power Amp Assembly; see Table 6J-1 below. For information pertaining to the A18—A21 YIG Driver PCBs, refer to Section 6L–YIG Driver. Refer also to the troubleshooting reference information contained in Sections 6A, 6B, and 6C.

Table 6M-1. YIG Loop / FM Modulation Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6J-1.1	6J-1
Block Diagram	Fig. 6J-1	6J-3
Troubleshooting	Tbl. 6J-2	6J-11
PCB LEVEL		
A12 YIG Phase Detector PCB		
Detailed Circuit Description	Para. 6J-2	6J-3
Block Diagram	Fig. 6J-1	6J-3
Troubleshooting	Tbl. 6J-2	6J-11
Parts Locator Diagram	Fig. 6J-3	6J-12
Schematic Diagram	Fig. 6J-4	6J-13
A16 FM PCB		
Detailed Circuit Description	Para. 6J-3	6J-5
Block Diagram	Fig. 6J-2	6J-7
Troubleshooting	Tbl. 6J-2	6J-11
Parts Locator Diagram	Fig. 6J-5	6J-14
Schematic (Sheet 1 of 4)	Fig. 6J-6	6J-15
(Sheet 2 of 4)	"	6J-16
(Sheet 3 of 4)	"	6J-17
(Sheet 4 of 4)	"	6J-18
A30 Sampler/ IF Amp Assembly		
Detailed Circuit Description	Para. 6J-5	6J-9
Troubleshooting	Tbl. 6J-2	6J-11
Parts Locator Diagram	Fig. 6J-7	6J-19
Schematic Diagram	Fig. 6J-9	6J-21
A31 Multiplier/ Power Amp Assembly		
Detailed Circuit Description	Para. 6J-4	6J-9
Troubleshooting	Tbl. 6J-2	6J-11
Parts Locator Diagram	Fig. 6J-8	6J-20
Schematic Diagram	Fig. 6J-10	6J-22

6J-1.1 YIG Loop/FM Subsystem Overall Functional Description

The YIG phase-lock loop portion of this subsystem is used to fine-tune the YIG oscillator to the exact output frequency entered by using the front panel keys or via the GPIB. It also reduces FM noise close to the carrier. The FM portion of the subsystem provides the 67XXA with frequency modulation capability in both phase-locked and unlocked modes of operation.

a. YIG Loop Functions

Refer to the overall YIG loop functional block diagram, Figure 6J-1. One input to the YIG-loop Sampler/IF Amplifier is a 198-220 MHz signal which is derived from the 396-440 MHz output from the coarse loop oscillator by the A31 Power/Amp Multiplier assembly. This signal drives the step-recovery diode (also part of the A31 assembly) that produces harmonics from 1.98 to ≈ 40 GHz. This harmonic comb is fed to the input of the A30 Sampler/IF Amplifier assembly.

The other input to the Sampler/IF Amplifier is a sample of RF power from the YIG oscillator output. Sampling the YIG output signal at the rate of the adjacent coarse-loop harmonic produces a low frequency difference signal which is the YIG IF signal (20-32.1 MHz).

The synthesizer main microprocessor programs the coarse-loop output frequency so that one of its harmonics will be within 20-32.1 MHz of the desired YIG operating frequency. The YIG Phase Detector compares the YIG IF signal to a 20-32.1 MHz frequency reference signal that is derived from the 200-321 MHz output from the fine-loop oscillator. The YIG phase detector fine tunes the YIG via the YIG FM coil driver to eliminate any frequency difference between the two signals.

Phase locking the YIG over a broad frequency range is accomplished by programming the coarse-loop to various frequencies that have harmonics close to the desired operating frequencies. Exact frequency tuning for each desired operating frequency is accomplished by programming of the fine-loop oscillator. (In each case, the YIG oscillator is first tuned via its main tuning coil to the approximate desired operating frequency.)

The programming (tuning) range of the coarse-loop oscillator provides harmonics ≥1.98 GHz that can be set in steps of from one to several megahertz over a frequency range greater than or equal to the spacing between harmonics. Thus, any YIG output frequency can be down converted to a YIG IF signal between 20-32.1 MHz. Since the coarse-loop output is synthesized, its frequency can be adjusted only in finite steps. The resulting harmonic steps may be as large as 12.1 MHz at high frequencies.

The YIG loop is fine tuned by varying the 20-32.1 MHz reference frequency signal applied to the YIG loop phase detector. This signal is derived by dividing the fine-loop oscillator signal by a factor of 10. By programming the fine-loop oscillator, this signal can be adjusted in 1 kHz increments over a 20-32.1 MHz range. The resolution of the fine-loop oscillator (hence the resolution of the RF output signal) is 1 kHz, which is much finer resolution than is available from the coarse-loop alone.

NOTE

> Whenever the synthesizer is operating in the phase-locked mode, the frequency of the YIG IF will always equal $^1/_{10}$ the frequency of the fine-loop oscillator.

For applications requiring resolution finer than 1 kHz, an external 20-32.1 MHz synthesizer can be connected at the rear panel to substitute for the internal fine-loop signal. The tuning resolution is then determined by the resolution of the external synthesizer.

b. FM Modulation Functions

In addition to the YIG frequency phase lock control circuitry, the YIG loop contains the FM modulation circuitry that allows the user to frequency modulate the RF output waveform. A portion of this circuitry is also used for the narrow band sweep function (i.e., sweeps ≤50 MHz).

The external FM signals from the front and rear panel connectors are routed to input buffer amplifiers and combined. The output of the input amplifier chain is fed to the input of the filter networks.

In the phase-locked mode of operation, the FM circuits are configured to operate as follows:

- The FM modulation signal is filtered, as DC FM operation is not possible in this mode. The filter selection in this mode is normally under control of the synthesizer main microprocessor.
- The FM Integrator circuit is not bypassed in this mode; therefore, the FM modulation signal from the amplifier/filter circuits is integrated. This circuit also amplifies the FM modulation signal by a factor approximately equal to the YIG phase-lock loop gain factor and with the same response characteristics (i.e., high gain at low frequencies, decreasing gain as the modulating frequency increases).
- The output of the Integrator circuit is fed into to the A12 PCB YIG Phase Lock circuitry to cancel the correction error signal that is caused by the frequency modulation of the YIG output signal. Without this function, modulation frequencies below the YIG loop bandwidth (approximately 10 kHz) would be removed by the YIG phase-lock loop circuitry.
- The attenuated FM modulation signal is combined with the YIG frequency error signal at the input of the FM Deviation Limiter circuit. The combined signal output from this circuit then goes to the FM amplifier in the normal manner (see below).

In the unlocked mode of operation, the FM circuits are configured to operate as follows:

- The FM modulation signal is not filtered (i.e., DC FM operation is selected).
- The FM Integrator circuit is bypassed in this mode; therefore, the FM modulation signal from the amplifier/filter circuits is not integrated.

In both FM operating modes, the output of the amplifier/filter circuits (U4) goes to the input of the FM attenuator circuit and the input of the FM peak detector circuit. The output from the FM attenuator circuit goes to the FM limiter, FM sensitivity circuits, and FM output amplifier.

The FM output from the A16 PCB is routed to the A18–A21 YIG driver PCB(s). The FM amplifier of the YIG driver board selected by the main processor drives the FM coil of the YIG oscillator assembly.

The field produced by the YIG FM coil interacts with the magnetic field that results from the current flow through the YIG main tuning coil. The modulation of this magnetic field changes the frequency of the YIG oscillator at the rate of the modulating frequency. Maximum deviation in the unlocked mode is ±25 MHz.

For narrow band analog sweeps (<50 MHz), the ramp voltage from the A17 PCB goes to the Sweep Amp. The Sweep Amp applies the ramp through S3 to the FM Amp on the A18–A21 YIG Driver PCBs. This improves the residual FM characteristics during narrow band sweeps.

6J-2 A12 YIG PHASE DETECTOR PCB CIRCUIT DESCRIPTION

The circuits located on the A12 PCB provide the frequency/phase locking functions for the YIG loop. Refer to Figure 6J-1, and to the A12 PCB schematic diagram, Figure 6J-4.

6J-2.1 Sampler/IF Amplifier Input Circuit

The 20-32.1 MHz IF signal from the A30 Sampler/IF is input at connector A12J4 (the signal level at this connector is approximately 0 dBm). Resistors R6 and R7 comprise a resistive pad that attenuates and isolates the A12J3 test connector. This test point can be monitored by an oscilloscope, network analyzer, or spectrum analyzer to monitor what is happening inside the YIG loop. The signal level at A12J3 is approximately 12 dB down from the level at A12J4. The signal at A12J4 goes to transistor Q7, which has a gain of approximately 10 dB; the output from Q7 goes to Q8 which converts the signal to TTL levels. From the collector of Q8, the signal goes to U3 which divides the signal by 10 and applies it to U4, which is the phase/frequency detector for the YIG loop.

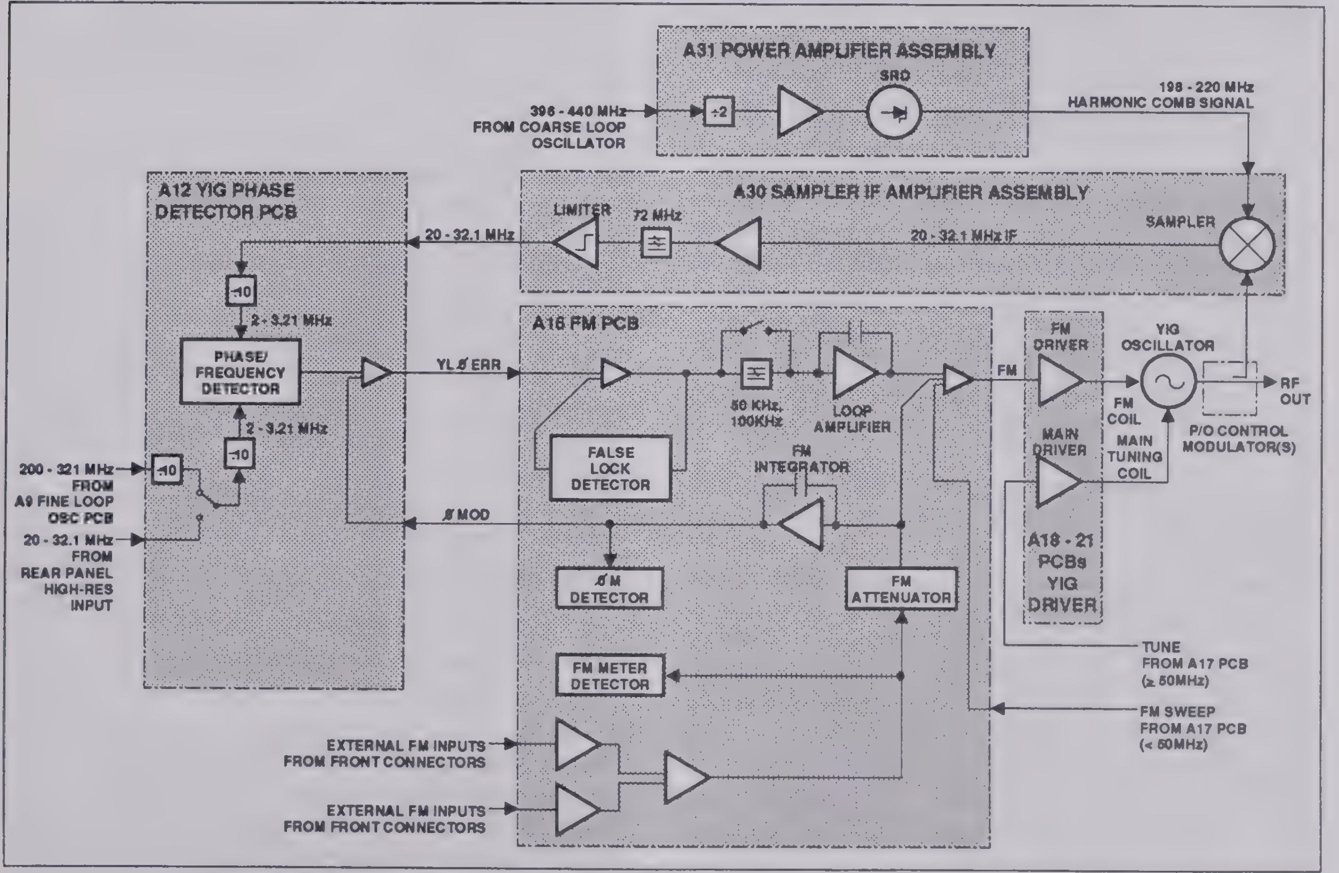

A31 POWER AMPLIFIER ASSEMBLY
SRD
396 - 440 MHz FROM COARSE LOOP OSCILLATOR
÷2
198 - 220 MHz HARMONIC COMB SIGNAL
A12 YIG PHASE DETECTOR PCB
A30 SAMPLER IF AMPLIFIER ASSEMBLY
LIMITER
72 MHz
20 - 32.1 MHz
20 - 32.1 MHz IF
SAMPLER
÷10
2 - 3.21 MHz
PHASE/ FREQUENCY DETECTOR
2 - 3.21 MHz
÷10
÷10
200 - 321 MHz FROM A9 FINE LOOP OSC PCB
20 - 32.1 MHz FROM REAR PANEL HIGH-RES INPUT
A16 FM PCB
YL Ø ERR
Ø MOD
FALSE LOCK DETECTOR
50 KHz, 100KHz
LOOP AMPLIFIER
FM INTEGRATOR
ØM DETECTOR
FM ATTENUATOR
FM METER DETECTOR
FM
FM DRIVER
MAIN DRIVER
A18 - 21 PCBs YIG DRIVER
YIG OSCILLATOR
FM COIL
MAIN TUNING COIL
RF OUT
P/O CONTROL MODULATOR(S)
TUNE FROM A17 PCB (≥ 50MHz)
FM SWEEP FROM A17 PCB (< 50MHz)
EXTERNAL FM INPUTS FROM FRONT CONNECTORS
EXTERNAL FM INPUTS FROM FRONT CONNECTORS

Figure 6J-1. Overall Block Diagram of YIG Loop/FM Modulation Subsystem

6J-2.2 200-321 MHz Fine Loop Oscillator Input and Divider Circuits

The output signal from the A9 Fine-Loop Oscillator PCB is input at A12J1 (signal level ≈ –5 dBm). It is coupled by C3 to X5 amplifier, Q1. The output of Q1 is coupled to the ECL input of U1, which is a dual modulus divider configured to divide by 10 at all times. The TTL output of U1 goes to U5A, which is a NAND gate that is used as a switch. When the L HIGH RES EN signal from the A16 PCB is high, U5A-2 and U5B-5 will be high and the 20-32.1 MHz signal from U1 goes to U2, which is another divide-by-10 counter. The 2-3.21 MHz TTL signal from U2 is the frequency reference signal that is connected to one input of the YIG phase/frequency detector circuit comprised of U4A and U4B.

6J-2.3 Phase/Frequency Detector Circuit

This circuit compares the 2-3.21 MHz output signal from the A30 Sampler/IF Amplifier signal with the 2-3.21 MHz output signal from U2, which is derived from the Fine-Loop Oscillator signal. This circuit is a "D" flip-flop phase detector circuit comprised of U4A , U4B and U5C.

Whenever the input signal at pin 13 of U4 leads the input signal at pin 1, the waveform at the Q2 output (pin 9) will be of longer duration than that at the Q1 output (pin 5). Conversely, whenever the signal at pin 1 lags that at pin 5, the waveform duration at Q2 will be of shorter duration. When both input signals are in phase, both Q output signals will be approximately equal (≈20 ns).

Resistors R25/R28 and capacitor C20 along with R27/R29 and C21 comprise RC filters that integrate the output waveforms of U4 Q1 and Q2 respectively. These filters also reduce the 2-3.21 MHz phase detector reference frequency sidebands. The outputs of the filters go to the inputs of differential receiver, U6. The output of U6 is the YIG phase error signal. If R30 were not in the circuit, the output of U6 would be 0V when the YIG loop was locked. However, R30 provides a phase offset of about 30 degrees to prevent the phase detector from operating in its dead zone. This is especially important during phase modulation.

Differential receiver U6 has a X4 gain. The output of U6 is the YL Ø ERR signal that is routed to the A16 FM board via the A28 Mother Board. Under locked conditions, The voltage at this point will be 0V. When the YIG loop is unlocked, the voltage will be +12V or –12V.

Resistors R45/R46 and capacitor C10, filter the YIG error signal and provide isolation for the U6 output. The output of this filter is the YL MON signal that is routed to the DVM located on the A17 Analog Instruction PCB. The DVM monitors this point for phase lock.

The Ø MOD and Ø MOD REF phase modulation signals from the A16 FM board are filtered by the RC filter networks comprised of R39, C26, R40 and R38, C27, and R41. These filtered signals are combined with the YIG phase error signal that are input to the phase detector, U6. During the FM modulation mode of operation, these signals change the offset of the phase detector at the FM modulation rate. This cancels the error signal generated by the phase detector circuits in response to the FM modulation. Without this canceling effect, the phase lock loop would remove any FM modulation applied to the YIG output signal that is within the 10 kHz YIG loop bandwidth.

6J-2.4 External 20-32.1 MHz Synthesizer Input

The 20-32.1 MHz external signal from the rear panel HIGH RES INPUT connector is input at A12J2. This signal is fed to the input amplifier comprised of Q4 and Q5. The output of Q5 goes to one input of gate U5D. Whenever the L HIGH RES EN signal is set to the low state by the main microprocessor, the gating circuits comprised of U5A, U5B and U5D will be passed to the input of U2 to be used as the YIG IF reference frequency input to the phase/frequency detector circuits. This control line also disables the Fine Loop oscillator (A9 PCB). During normal operation, the L HIGH RES EN signal is in the high state and the U1 output signal (i.e., the divided A9 Fine-Loop Oscillator signal) will be passed to the input of U2.

When an external synthesizer or other signal source is used replace the internal 67XXA Fine Loop Oscillator signal, the characteristics of the YIG RF output signal will be dependent on the characteristics of the external signal source. If the phase noise of the external synthesizer is equal to or better than the divided 67XXA Fine Loop signal, then the phase noise of the RF output signal will not be degraded. The RF output signal will also have the same frequency stability and tuning resolution characteristics of the external source.

Normally, this mode of operation is used only with a GPIB controller, as the frequency of the external source must be calculated for each desired 67XXA output frequency. This is easily done using a GPIB controller, as this can be implemented by a simple program. There are also "hidden key" functions to enable this input from the front panel for troubleshooting purposes. These codes are listed in Section 6C–Troubleshooting.

6J-3 A16 FM PCB CIRCUITS DESCRIPTION

The circuitry contained on the A16 FM PCB provides the following functions: YIG frequency/phase locking, FM modulation, and narrow band sweep operations. Refer to the overall block diagram of the A16 PCB, Figure 6J-2, and to the A16 PCB schematic diagram, Figure 6J-6.

6J-3.1 Digital Control

All of the functions of the A16 PCB are controlled by the synthesizer main microprocessor. The U5 Address Decoder decodes the PA0-PA2 lines and generates strobes that latch instructions and data into the latches and DACs that control the various A16/A12 PCB functions. Decoder U5 is enabled by the low-active L PA16 control line from the microprocessor; this line is the unique address line for the A16 PCB.

Data latch U6 buffers the microprocessor data bus lines from the internal A16 data bus. YIG Loop Control latch U9 provides control for various Yig Loop functions located on the A16 and U12 PCBs. The FM Control Latch, U7, provides control for the FM attenuator DAC and the various analog switches used in the FM circuits..

6J-3.2 A16 YIG Phase-Lock Circuits

The phase-lock error signal from the A12 YIG Phase Detector goes to buffer amplifier U19B. The U27 False Lock Detector prevents a false lock on signals that result whenever the IF output of the Sampler/IF Amplifier goes through a zero beat. From U19B, the error signal goes to notch filters, which remove the fractional-division sidebands that result from the fine/coarse-loop oscillator divider circuits. During the time that phase-lock is being acquired, switch U22C closes to bypass these filters and give a faster locking time. After phase-lock is acquired, U22C opens to insert the notch filters. The error signal then goes to loop amplifier U23. In unlocked modes, analog switch U18B closes to keep the U23 output signal off of the operational amplifier's supply rail.

From U23 the error signal goes through analog switch U18C to the FM Deviation Limiter, U24; this circuit limits the deviation of the FM system to approximately ±40 MHz, which prevents saturation of the circuits following U24. This improves response time and eliminates overdrive conditions.

From U24, the error signal goes to output amplifier U25 and to the U20 FM Sensitivity Cal DAC. The Cal DAC can adjust the sensitivity approximately ±10%. There are variations in YIG oscillator sensitivities, and component variation in the FM driver circuits; the Cal DAC provides a means to compensate for these variations. The Cal DAC data for each YIG oscillator driver is stored in EEPROM on the A23 PCB. At the bandswitch points, this data sets the DAC so that each YIG driver has the same sensitivity. This provides for a more constant loop gain. It is also a requirement for a calibrated FM and sweep width.

6J-3.3 FM Input Amplifiers and Filters

The external FM modulation signals from the front and rear panel connectors go to the input buffer amplifiers U1A and U1B, respectively. Diodes CR1-CR4 and resistors R2 and R5 provide overdrive protection for U1A and U1B. Resistors R1 and R6 provide the terminations for the two external FM modulation signal inputs.

The outputs of U1A and U1B go to the input of differential receiver amplifier U2, which sums the two external modulation signal inputs. The output of U2 is applied to the inputs of the two filter networks and to analog switch U3A.

In the unlocked FM mode of operation, the main microprocessor selects the DC FM path (U3A closed) and extends the FM deviation range from dc to 25 MHz/V.

In the phase-lock mode of operation, the phase detector does not have the range to allow DC FM operation, and analog switch U3B is opened. At FM deviations up to 300 kHz/V, U3B is closed and the FM modulation signal goes through the 30 Hz HPF (high-pass filter) comprised of C6, R106 and R13 . At deviations between 300 kHz/V to 5 MHz/V, it goes through the 1 kHz HPF comprised of C4, C5, R11, and R12. The microprocessor selects these filters based on the deviation range selected by the operator.

From the selected filter, the FM signal goes to buffer amplifier U4, which provides a constant impedance to the filter circuits. It is inverting or non-inverting, depending on the position of W5-W8 jumpers.

Jumpers W5-W8 provide a means of changing the polarity of the modulation signal. Normally, a negative going modulation signal causes the RF output frequency to increase. By removing W5 and W6 and installing W7 and W8, the frequency will increase with a positive input. From U4, the FM signal goes to U28 FM peak detector and U10 FM attenuator DAC.

6J-3.4 FM Attenuator Circuits

These circuits include DAC U10, buffer amplifier U11, and two 20 dB attenuators comprised of resistors R24-R27 and analog switches U12A-U12D. Whenever the user enters a FM Sensitivity value via the front panel (or GPIB), the main microprocessor sets the DAC/attenuators accordingly. The attenuator circuits provide a resolution control of approximately 0.02 dB throughout a 90 dB dynamic range.

The two 20 dB attenuators are used to provide high values of attenuation, therefore allowing the DAC to be used only for low attenuation values. This avoids AC feedthrough of the DAC at high frequencies.

Buffer amplifier U13B provides a high impedance load to the attenuators. With U10 DAC set for 0 dB attenuation and the 20 dB attenuators in the 0 dB attenuation state, the signal at the output of U13B will be 5V peak for a 1V peak input signal. At 10 kHz peak deviation, this signal will be about 50 uV peak for a 1V peak input signal.

From U13B, the FM signal goes to the input of the FM integrator and to analog switch U18D for application to the input of the FM Deviation Limiter.

6J-3.5 FM Integrator Circuits

The FM integrator circuits generate a signal that is fed into to the A12 PCB YIG phase lock circuits to cancel the correction error signal that is caused by the frequency modulation of the YIG output signal. Without this function, modulation frequencies below the YIG loop bandwidth (approximately 10 kHz) would be removed by the YIG phase-lock loop circuitry.

The FM integrator circuits amplify the FM modulation signal by a factor approximately equal to the YIG phase-lock loop gain factor and with the same response characteristics. This signal is inverted and fed back to the A12 PCB.

The signal from the FM attenuator goes to amplifier U13A, which has a decreasing gain with increasing frequency characteristic. From U13, the signal goes to amplifier, U15. The input circuit of U15 includes the limiting network comprised of CR13, CR14 and R33. This circuit provides overdrive protection in the event of sudden level changes, such as connecting and disconnecting the FM nodulation signal source.

From U15, the signal goes to the input of the phase modulation sensitivity DAC, U20A. The outputs of U15 and U20A are summed by R37 and R29 at the input of U16. This provides adjustment of the frequency response of the signal generated by the FM integrator so it can be matched to that of the phase lock loop. The phase modulation sensitivity DAC is adjusted during the FM frequency response adjustments during calibration.

Amplifier U16 also has a decreasing gain with increasing frequency characteristic. From U16, the FM signal goes to amplifier U17, which is also overdrive protected by CR15–CR18. From U17, the FM signal goes to the phase modulation metering circuits and to A12 YIG phase detector.

6J-3.6 False Lock Detector

The YIG phase error signal from the A12 PCB goes to differential receiver, U19B. From U19B, the error signal goes to the input of the notch filter circuits. Analog switch, U22A, is a bypass for the notch filters; when closed, it routes the error signal directly to the input of the YIG Loop Amplifier (U23).

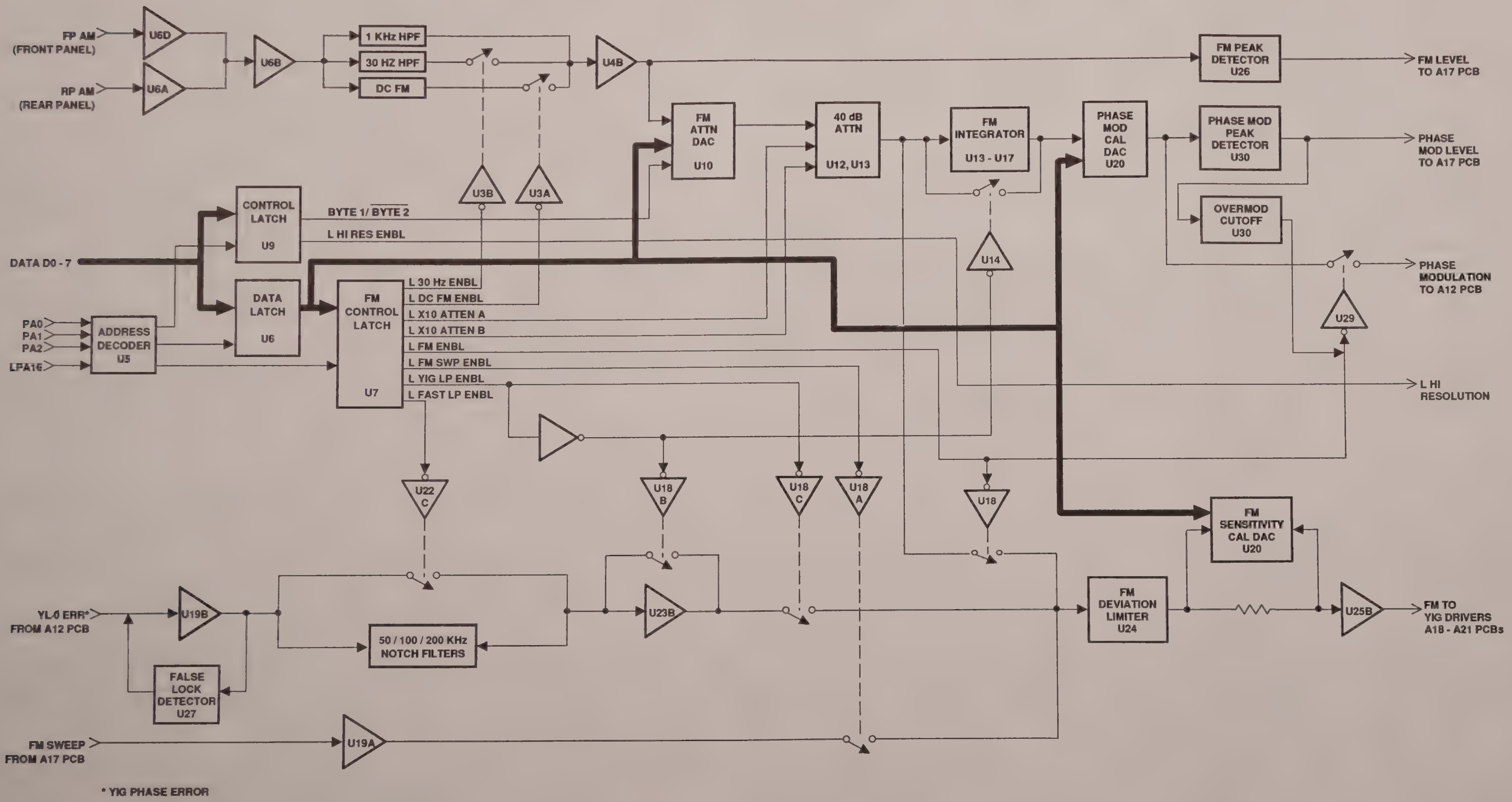

FP AM
(FRONT PANEL)
RP AM
(REAR PANEL)
U6D
U6A
U6B
1 KHz HPF
30 HZ HPF
DC FM
U4B
FM PEAK DETECTOR U26
FM LEVEL TO A17 PCB
FM ATTN DAC U10
40 dB ATTN U12, U13
FM INTEGRATOR U13 - U17
PHASE MOD CAL DAC U20
PHASE MOD PEAK DETECTOR U30
PHASE MOD LEVEL TO A17 PCB
OVERMOD CUTOFF U30
PHASE MODULATION TO A12 PCB
U3B
U3A
U14
U29
CONTROL LATCH U9
BYTE 1/ BYTE 2
L HI RES ENBL
DATA D0 - 7
DATA LATCH U6
FM CONTROL LATCH U7
L 30 Hz ENBL
L DC FM ENBL
L X10 ATTEN A
L X10 ATTEN B
L FM ENBL
L FM SWP ENBL
L YIG LP ENBL
L FAST LP ENBL
PA0
PA1
PA2
LPA16
ADDRESS DECODER U5
L HI RESOLUTION
U22 C
U18 B
U18 C
U18 A
U18
FM SENSITIVITY CAL DAC U20
YL0 ERR*
FROM A12 PCB
U19B
50 / 100 / 200 KHz NOTCH FILTERS
U23B
FM DEVIATION LIMITER U24
U25B
FM TO YIG DRIVERS A18 - A21 PCBs
FALSE LOCK DETECTOR U27
FM SWEEP FROM A17 PCB
U19A
* YIG PHASE ERROR

Figure 6J-2. A16 FM PCB Overall Block Diagram

The YIG phase error signal will contain high frequency signals whenever a change in the YIG frequency causes a zero beat with the harmonic comb signal from the A31 Power Amplifier. Because of the very high gain of the A30 Sampler/IF Amplifier, any noise at the zero beat will be amplified. It is possible for the YIG loop circuits to sense these signals as a coherent IF signal and to falsely lock at that point.

The output of U19B is amplified by U27B and only high frequency components of the signal are coupled by C32 to the doubling rectifiers, CR27 and CR28. These high frequency components of the signal are rectified by CR27 and CR28 and go to comparator, U27A . When U27A switches states, a DC level is fed back to U19B via CR26 which force s the YIG to a higher frequency. Resistors R80 and R77 set the comparison voltage of U27A to approximately 1 volt; R79 is a positive feedback path that provides hysteresis for this circuit.

6J-3.7 Notch Filter Circuits

Operational amplifiers U32A and U32B are configured as a notch filter with a center frequency of 200 kHz (this is the frequency of the main fractional division sidebands generated by the A6 Coarse Loop Divider). Operational amplifiers U33A and U33B comprise a 100 kHz notch filter that reduce any 100 kHz sidebands caused by the switching power supply and 100 kHz reference frequency signals generated by the A11 Fine Loop Divider. Operational amplifiers U34A and U34B comprise a 50 kHz notch filter that filter out any sidebands that are also caused by the 50 kHz switching frequency of the power supply.

When the YIG frequency in large increments, the notch filters are by-passed via analog switch U22A to provide a faster lock time; when lock is obtained, U22A is opened. The switching of U22A is controlled by the synthesizer main microprocessor. When U22A is closed, the output of U34 is swamped by the low output impedance of U19, and the signal from U19B is fed to the input of the YIG loop amplifier.

6J-3.8 YIG Loop Amplifier

Operational amplifier U23 is the YIG loop amplifier. When the YIG loop is phase locked, it has a loop bandwidth of approximately 10 kHz. When the notch filters are bypassed by analog switch U22A, the loop bandwidth is approximately 50 kHz. When the YIG loop is unlocked (during switching in step sweep, or in analog sweep mode) analog switch U18B is closed to prevent the output of U23 from limiting at ±15V. This provides faster locking when the YIG is within the capture range of the phase detector.

Whenever the loop is unlocked, analog switch U18C is opened, which disconnects the output of U23. This prevents the YIG FM coil from receiving an erroneous phase error voltage. When closed, U18C connects the phase error signal from U23 to the input of the FM Deviation Limiter amplifier, U24.

The processed phase error signal at the output of U23 is connected to the divider/filter network comprised of R74, R72 and C34. The YL TUNE MON signal is picked off at the junction of R74/R72. This signal is monitored by the DVM located on the A17 Analog Instruction PCB. The main microprocessor monitors this signal to determine if the YIG loop is phase locked, and also when performing various A17 Tune DAC adjustments. The amplitude of this monitor signal is approximately 5 MHz/V.

6J-3.9 FM Deviation Limiter

This circuit prevents over driving of the FM amplifiers located on the A18-A21 YIG driver PCBs. It limits the maximum FM modulation deviation to approximately 30 MHz.

The FM Deviation Limiter circuit is comprised of Amplifier U24 and associated components. Diode CR25 is a 6.8V zener diode. With no input to U24, there is approximately +3.4V on the cathode, and –3.4V on the anode. As the output of U24 reaches +4V, CR22 starts conducting, which starts to limit the signal. Diode CR23 functions in the same manner for negative-going signals. Diodes CR21 and CR24 limit the maximum signal swing to approximately ±8V.

There are three inputs to the FM deviation limiter circuit:

- The YIG phase error signal from U23, which is the processed output signal from the YIG loop phase detector circuit located on the A12 PCB. This signal is connected to the limiter circuit by analog switch U18C.
- The FM modulation signal from the FM sensitivity DAC, This signal is connected to the limiter circuit by analog switch U18D.
- The 10 V ramp signal from the A17 Analog Instruction PCB, which is used to generate analog (narrow band) sweep widths ≤50 MHz. This signal

is buffered by differential receiver amplifier U19. This signal is connected to the limiter circuit by analog switch U18A.

6J-3.10 FM Sensitivity Circuit

This circuit, which is comprised of U20B and operational amplifier U21 functions as a variable attenuator. It is used to adjust the FM modulation sensitivity to compensate for the slight variation in sensitivity of the YIG oscillators and the FM amplifier circuits on the A18-A21 YIG driver PCBs.

The output of U24 goes to the input of the FM sensitivity DAC, U20B. The outputs of U24 and U20B are summed by R68 and R70 at the input of U25. This provides an adjustment range of the FM sensitivity of approximately 16%, with a 0.12% adjustment resolution . The FM signal at the output of U25 has a nominal 4 MHz/Volt sensitivity

6J-4 A31 MULTIPLIER/POWER AMPLIFIER ASSEMBLY CIRCUIT DESCRIPTION

Refer to the schematic diagram of the A31 Multiplier/Power Amplifier assembly, Figure 6J-10. The 396-440 MHz –2 dBm signal from the A4 Coarse-Loop Oscillator is input at A31, J1. Transistor Q1 is a X5 amplifier that shifts the signal to the ECL levels required by U1. Integrated circuit U1 is a divide-by-two circuit that outputs a 198-220 MHz signal. Resistor R4 and capacitor C4 comprise an input biasing network for U1.

The output of U1 goes to the attenuator/impedance matching network consisting of R6, R5, R8, C6, and C8. Transistors Q2 and Q3 comprise a preamplifier that drives the power amplifier, Q4. The power level at the input to Q4 is approximately +27 dBm. The collector of Q4 is impedance matched to the step-recovery diode module by TL8, TL9, C24 and C20. (The step-recovery diode is part of the J2 output connector assembly.).

The step recovery diode produces a very sharp impulse signal that contains harmonics up to approximately 40 GHz. This signal is used to switch the sampling diodes in the sampler module portion of the A30 Sampler/IF Amplifier assembly.

6J-5 A30 SAMPLER/IF AMPLIFIER ASSEMBLY CIRCUIT DESCRIPTION

6J-5.1 Sampler Circuits

Refer to the schematic diagram of the A30 Sampler/IF Amplifier assembly, Figure 6J-9. The sampler module of the A30 assembly contains a high speed diode switch circuit. A sample of the YIG RF input signal is one input to the sampler module. A very sharp impulse waveform from the step-recovery diode module (which is part of the A31 Multiplier/Power Amplifier Assembly) is the other input. This impulse waveform turns on the sampling diodes, which sample the YIG RF input signal for a very short period of time.

When the YIG RF output frequency is tuned to an exact multiple of the Course-Loop signal that drives the step recovery diode *plus* 20 MHz, the resulting output from the sampler will be a 20 MHz sinewave that carries the FM information from the YIG RF output signal. The sampler output signal is fed to the (A30) IF amplifier circuits for amplification and limiting to remove any residual AM information it may contain.

6J-5.2 IF Preamplifier

Resistor R1 provides a DC return for the sampler diodes and C1 and C2 couple the IF signal to the IF preamplifier. Since the output impedance of the sampler is very high, Q1 FET amplifier presents a high input impedance to the sampler to prevent excessive loading. The output from the source of Q1 goes to emitter follower Q2. Resistors R9 and capacitor C6 increase the high frequency gain of this stage to compensate for the loss in output of the sampler with increasing frequency. The overall gain of the Q1-Q2 gain stage is about X1.

The signal from Q2 goes to amplifier stages Q3 and Q4 which have an overall voltage gain of approximately 24 dB. The signal from Q4 goes to Q5, which drives the 72 MHz Low Pass Filter.

6J-5.3 72 MHz Low Pass Filter

Inductors L1-L4 and C18-C22 comprise a 72 MHz low pass filter. This filter removes any signals caused by intermodulation products of the sampler, which are produced when harmonics of the RF signal mix with harmonics of the comb signal and produce image frequency signals.

6J-5.4 Limiter Circuit

The signal from the low pass filter goes to emitter follower Q6. The output from Q6 goes to Q7, which has an output of approximately 0.2 V peak. Whenever the output of Q7 exceeds this value, CR1 and CR2 will start conducting and provide degenerative feedback that will limit the output of Q7. The signal from Q7 goes to the input of the limiter stages comprised of Q8 and Q9, which are identical to Q7 and Q8.

Emitter follower Q10 drives the output connector, A30J5. Capacitor C36 couples the output signal from the emitter of Q10 to R52 which provides the 50 ohm output impedance for A30J5.

6J-6 YIG LOOP ASSEMBLIES, TROUBLESHOOTING

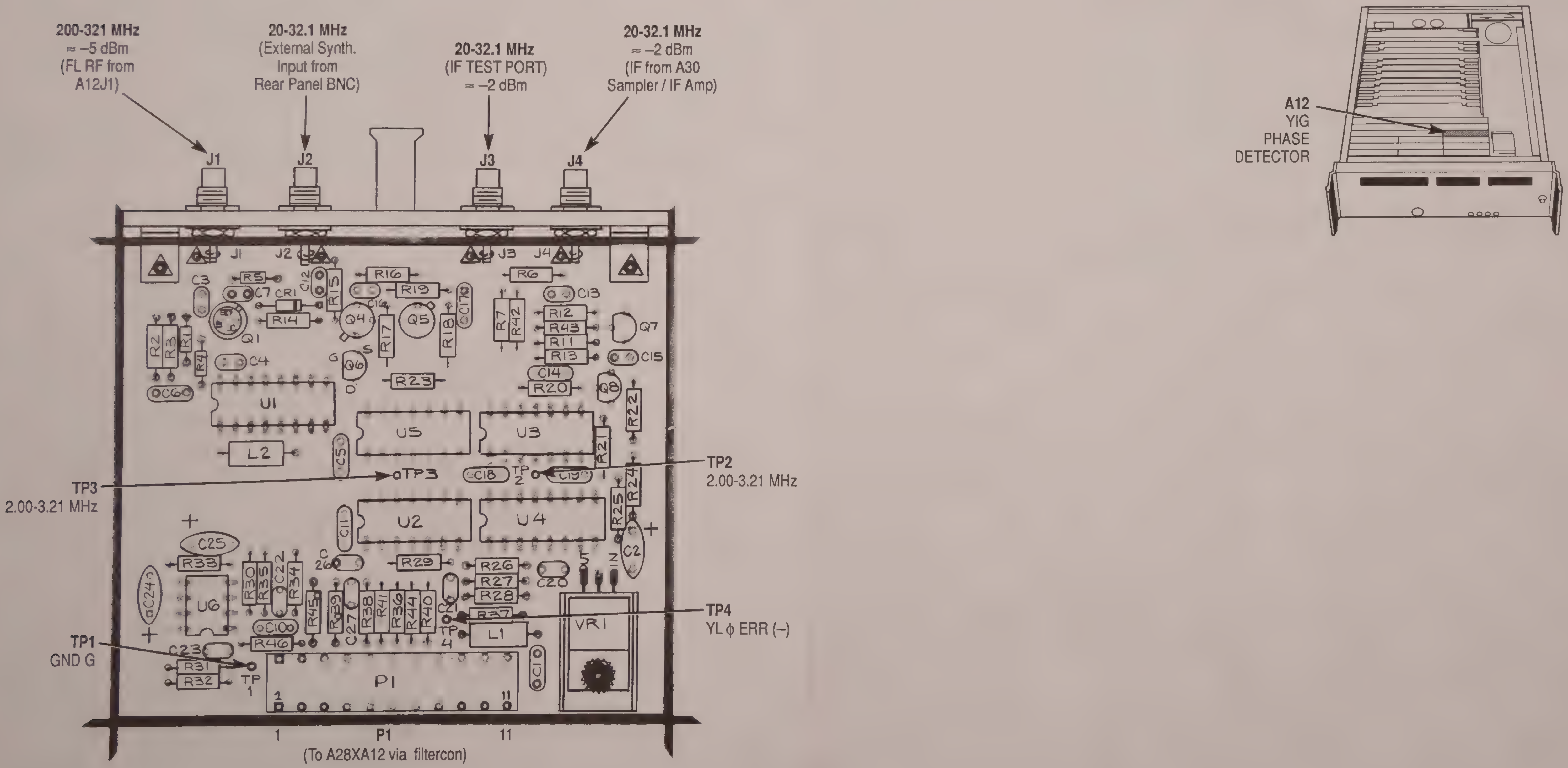
Table 6J-2 contains the list of 67XXA error codes that pertain to the A12 YIG Phase Detector PCB, A16 FM PCB, and the A30 Sampler/IF Amplifier and A31 Multiplier/Power Amplifier Assemblies. This table also includes troubleshooting procedures and suggestions for the A12 and A16 PCBs. Refer also to the troubleshooting reference information contained in Sections 6A, 6B, and 6C.

6J-7 YIG LOOP ASSEMBLIES SERVICE SHEETS

Table 6J-1, (located on the first page of this section) lists the block diagrams, schematic diagrams, and parts locator diagrams for the A12 and A12 PCBs that are contained in this section. It also lists the schematic diagrams and parts locator drawings for the A30 Multiplier/Power Amplifier and A31 Sampler/IF Amplifier assemblies.

Table 6J-2. YIG Loop/FM Modulation Troubleshooting

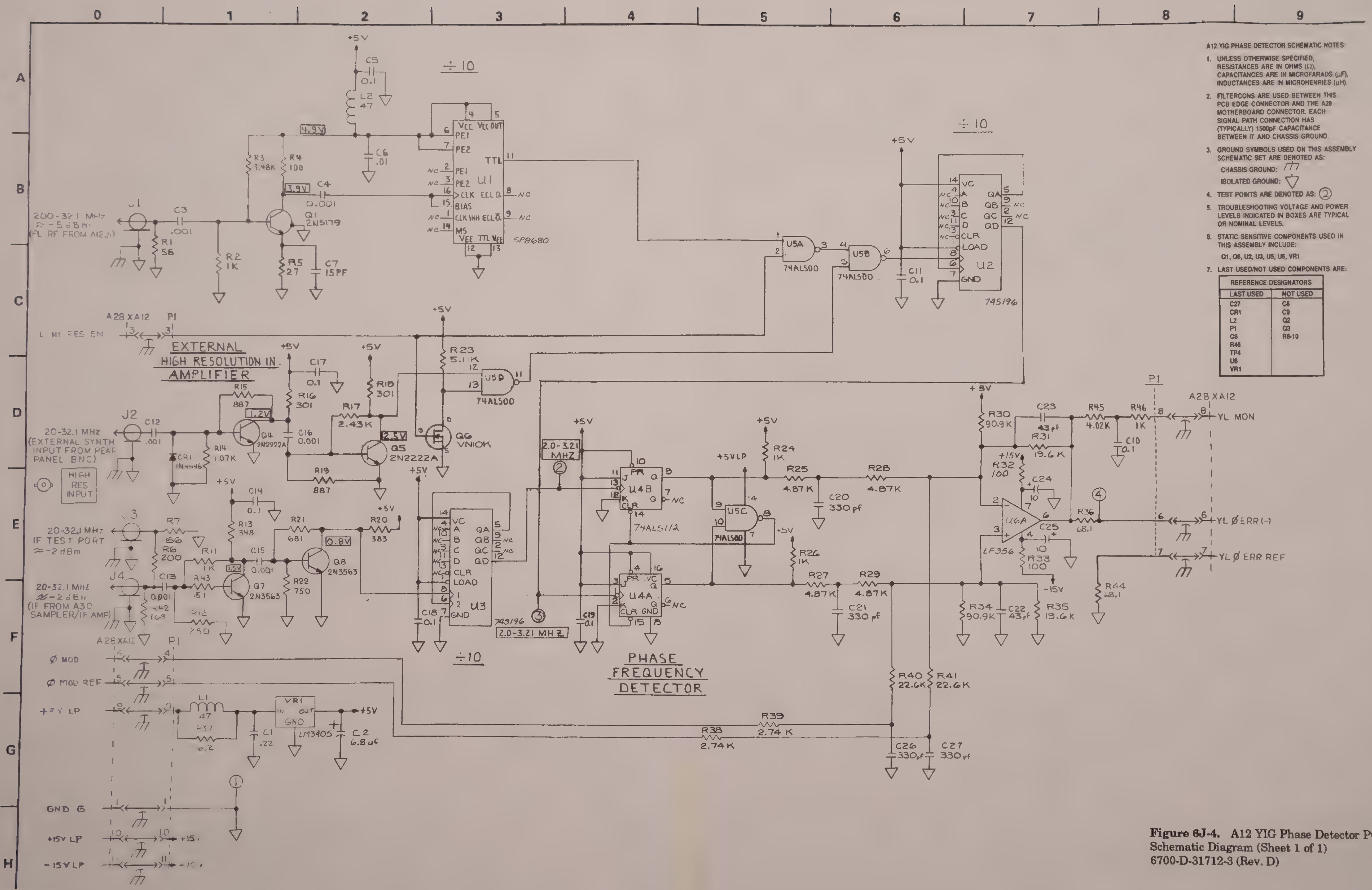
Error Code	Description	Remarks/Possible Problem Area
	A12 YIG Loop Tests	
	NOTE The E4-, E5-, and E9-series tests must have been successfully completed before these tests will be run. If any of the E4-, E5-, or E9-series tests fail, the E12-series tests are bypassed.	
E12-10	Phase Lock Error — The YIG Loop will not phase lock in any band. If completed successfully, the E12-11 and E12-12 tests are bypassed. If only one oscillator is not locking, the FM-path error code for that oscillator is displayed.	A12, A16, A30 and/or A31 PCBs
E12-11	Phase-Lock Negative Error	The reference signal from the A9 PCB is not being received.
E12-12	Phase-Lock Positive Error	No RF is being received from the A30 Sampler/IF PCB.
	A16 FM tests	
E16-10	FM 0 Error	The FM peak detector on A16 is inoperative: A16U28
E16-11	Phase Mod 0 Error	The Phase Modulation Peak Detector on the A16 PCB is inoperative: A16U30
E16-12	YIG Loop 0 Error	The loop amplifier for the YIG loop is inoperative.
E16-13	Sweep Path Error, YIG FM	The 50 MHz sweep path is inoperative.


200-321 MHz
≈ −5 dBm
(FL RF from A12J1)
J1
20-32.1 MHz
(External Synth. Input from Rear Panel BNC)
J2
20-32.1 MHz
(IF TEST PORT)
≈ −2 dBm
J3
20-32.1 MHz
≈ −2 dBm
(IF from A30 Sampler / IF Amp)
J4
TP3
2.00-3.21 MHz
TP2
2.00-3.21 MHz
TP4
YL ϕ ERR (−)
TP1
GND G
U1
U2
U3
U4
U5
U6
L1
L2
VR1
P1
1
11
A12
YIG
PHASE
DETECTOR

P1
(To A28XA12 via filtercon)

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6J-3. A12 YIG Phase Detector PCB Parts Locator Diagram
6700-D-31712-3 (Rev. D)


÷10
+5V
C5 0.1
L2 47
C6 .01
4.9V
3.9V
R3 3.48K
R4 100
C4 0.001
Q1 2N5179
C3 .001
J1
200-321 MHz ≈-5dBm (FL RF FROM A12J1)
R1 56
R2 1K
R5 27
C7 15PF
U1
SP8680
VCC VCC OUT PE1 PE2 PE1 PE2 CLK BIAS CLK INH MS VEE TTL VEE ECL Q ECL Q̄ TTL
NC
÷10
U2
74S196
VC A B C D CLR LOAD GND QA QB QC QD
U5A 74ALS00
U5B 74ALS00
C11 0.1
A28XA12 P1
L HI RES EN
EXTERNAL HIGH RESOLUTION IN AMPLIFIER
R23 5.11K
U5D 74ALS00
Q6 VN10K
C17 0.1
R15 887
1.2V
R16 301
R18 301
R17 2.43K
2.5V
Q4 2N2222A
Q5 2N2222A
C16 0.001
R19 887
J2
C12 .001
20-32.1 MHz (EXTERNAL SYNTH INPUT FROM REAR PANEL BNC)
CR1 1N4446
R14 1.07K
HIGH RES INPUT
J3
20-32.1 MHz IF TEST PORT ≈-2dBm
R7 56
R6 200
C14 0.1
R13 348
R21 681
R20 383
0.8V
R11 1K
1.5V
C15 0.001
Q8 2N3563
Q7 2N3563
R22 750
R43 51
J4
C13 0.001
20-32.1 MHz ≈-2dBm (IF FROM A30 SAMPLER/IF AMP)
R42 16.9
R12 750
U3
74S196
C18 0.1
÷10
2.0-3.21 MHZ
2.0-3.21 MHZ
U4B
U4A
74ALS112
PR J K CLR Q Q̄ VC GND
C19 .01
PHASE FREQUENCY DETECTOR
U5C 74ALS00
+5VLP
R24 1K
R25 4.87K
R28 4.87K
C20 330pf
R26 1K
R27 4.87K
R29 4.87K
C21 330pf
R30 90.9K
C23 43pf
R31 19.6K
R32 100
C24 10
+15V
U6A LF356
C25 10
R33 100
-15V
R36 68.1
R34 90.9K
C22 43pf
R35 19.6K
R45 4.02K
R46 1K
C10 0.1
R44 68.1
P1
A28 XA12
YL MON
YL Ø ERR (-)
YL Ø ERR REF
Ø MOD
Ø MOD REF
+9V LP
L1 47
R37 6.2
C1 .22
VR1 LM3405 IN OUT GND
C2 6.8uf
R40 22.6K
R41 22.6K
R38 2.74K
R39 2.74K
C26 330pf
C27 330pf
GND
+15V LP
-15V LP
+15
-15

A12 YIG PHASE DETECTOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏦
   ISOLATED GROUND: ▽
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   Q1, Q6, U2, U3, U5, U6, VR1
7. LAST USED/NOT USED COMPONENTS ARE:

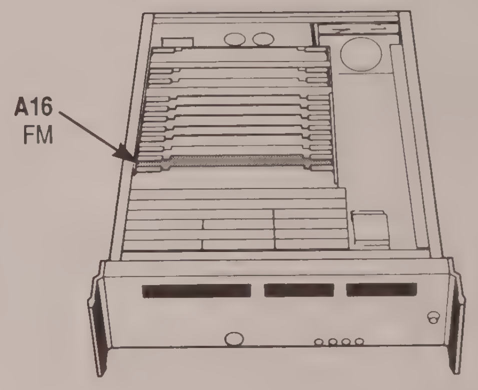
REFERENCE DESIGNATORS	
LAST USED	NOT USED
C27	C8
CR1	C9
L2	Q2
P1	Q3
Q8	R8-10
R46	
TP4	
U6	
VR1	

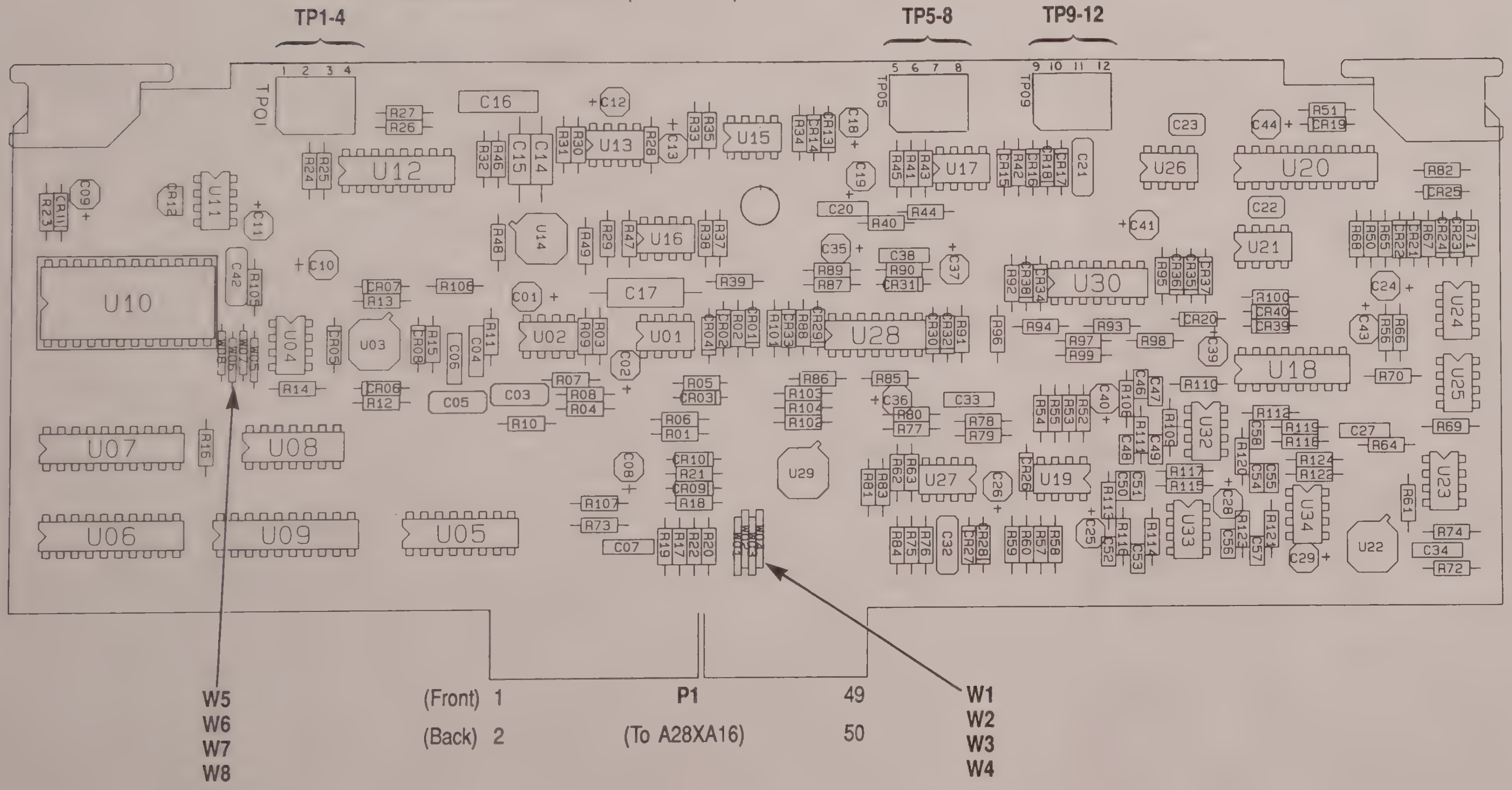
Figure 6J-4. A12 YIG Phase Detector PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31712-3 (Rev. D)

TEST POINTS

TP1	GND G	**TP7**	φ MOD
TP2	FM	**TP8**	Not Used
TP3	FM ATTEN DAC OUT	**TP9**	GND G
TP4	ATTEN FM	**TP10**	FM SENS DAC OUT
TP5	GND G	**TP11**	FM DEV LIMITER OUT
TP6	FALSE LOCK DET OUT	**TP12**	FM (+)

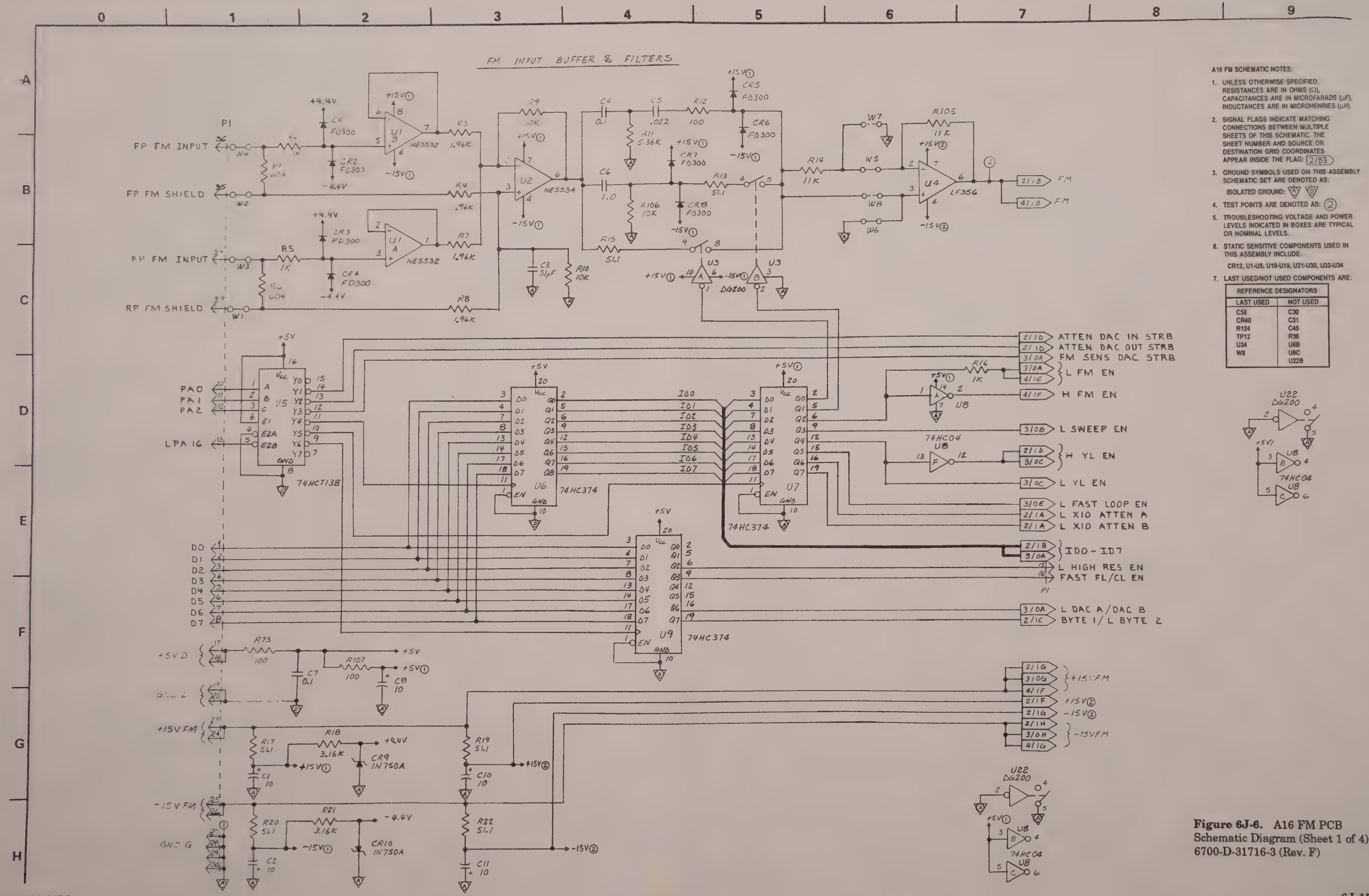
All test point measurements are made with reference to GND G (TP1 or TP9).




TP1-4
TP5-8
TP9-12
W5
W6
W7
W8
(Front) 1
(Back) 2
P1
(To A28XA16)
49
50
W1
W2
W3
W4

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6J-5. A16 FM PCB Parts Locator Diagram 6700-D-31716-3 (Rev. F)


FM INPUT BUFFER & FILTERS
P1
FP FM INPUT
FP FM SHIELD
FP FM INPUT
RP FM SHIELD
U1 B NE5532
U1 A NE5532
U2 NE5534
U3 A
U3 B
DG200
U4 LF356
R105 11K
R14 11K
R9 10K
R12 100
R13 51.1
R15 51.1
R106 10K
R11 5.36K
C4 0.1
C5 .022
C6 1.0
C3 51pF
R10 10K
CR5 FD300
CR6 FD300
CR7 FD300
CR8 FD300
W5
W6
W7
W8
2/1B FM
4/1B FM
PA0
PA1
PA2
LPA 16
U5 74HCT138
U6 74HC374
U7 74HC374
U9 74HC374
U8 74HC04
D0
D1
D2
D3
D4
D5
D6
D7
ID0
ID1
ID2
ID3
ID4
ID5
ID6
ID7
2/1D ATTEN DAC IN STRB
2/1D ATTEN DAC OUT STRB
3/0A FM SENS DAC STRB
3/0A 4/1E L FM EN
4/1F H FM EN
3/0B L SWEEP EN
2/1D 3/0C H YL EN
3/0C L YL EN
3/0E L FAST LOOP EN
2/1A L X10 ATTEN A
2/1A L X10 ATTEN B
2/1B 3/0A ID0 - ID7
L HIGH RES EN
FAST FL/CL EN
3/0A L DAC A/DAC B
2/1C BYTE 1/ L BYTE 2
+5V D
GND D
+15V FM
-15V FM
GND G
R73 100
R107 100
C7 0.1
C8 10
R17 51.1
R18 3.16K
CR9 1N750A
C1 10
R19 51.1
C10 10
R20 51.1
R21 3.16K
CR10 1N750A
C2 10
R22 51.1
C11 10
2/1G 3/0G 4/1F +15VFM
2/1F +15V②
2/1G -15V②
2/1H 3/0H 4/1G -15VFM
U22 DG200

A16 FM SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   ISOLATED GROUND: Ⓐ Ⓓ
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   CR12, U1-U5, U10-U19, U21-U30, U32-U34
7. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C58	C30
CR40	C31
R124	C45
TP12	R36
U34	U8B
W8	U8C
	U22B

Figure 6J-6. A16 FM PCB Schematic Diagram (Sheet 1 of 4) 6700-D-31716-3 (Rev. F)

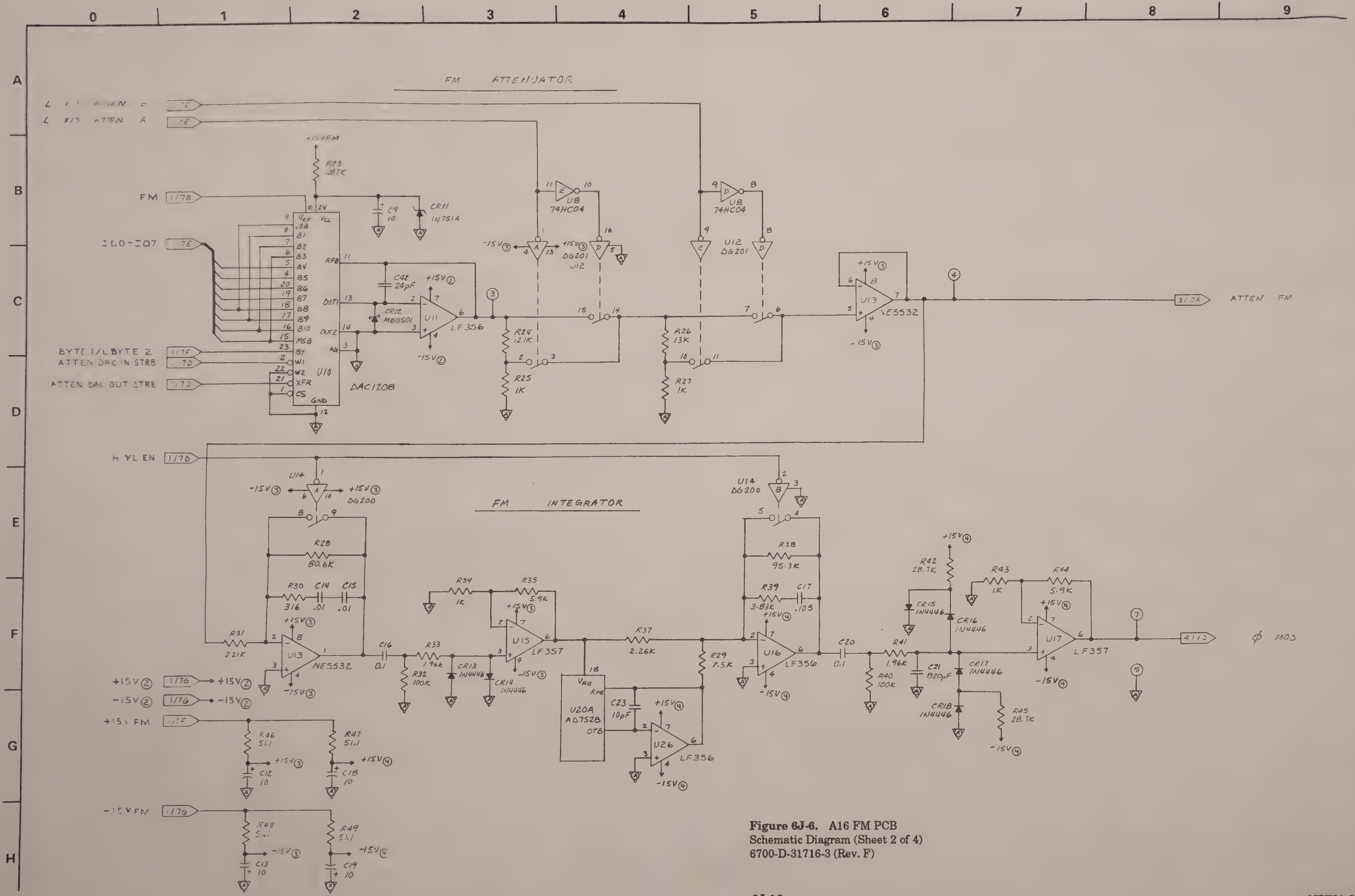

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
FM ATTENUATOR
L X10 ATTEN A
+15VFM
R23 .87K
FM 1/7B
ID0-ID7 7E
C9 10
CR11 1N751A
U8 74HC04
DG201 U12
U12 DG201
BYTE 1/L BYTE 2 1/7F
ATTEN DAC IN STRB 7D
ATTEN DAC OUT STRB 7D
U10 DAC1208
C42 24pF
CR12 MBD501
U11 LF356
+15V②
-15V②
-15V③
+15V③
R24 12.1K
R25 1K
R26 13K
R27 1K
U13 NE5532
3/10A
ATTEN FM
H YL EN 1/7D
U14 DG200
FM INTEGRATOR
R28 80.6K
R30 316
C14 .01
C15 .01
R31 221K
C16 0.1
R32 100K
R33 1.96k
R34 1K
R35 5.9k
U15 LF357
CR13 1N4446
CR14 1N4446
R37 2.26K
R29 7.5K
U20A AD7528
C23 10pF
U26 LF356
R38 95.3K
R39 3.83K
C17 .105
U16 LF356
C20 0.1
R40 100K
R41 1.96K
C21 820pF
R42 28.7K
CR15 1N4446
CR16 1N4446
CR17 1N4446
CR18 1N4446
R45 28.7K
R43 1K
R44 5.9K
U17 LF357
4/11D
ϕ MOD
+15V② 1/7G
-15V② 1/7G
+15V FM 1/7F
R46 51.1
R47 51.1
C12 10
C18 10
+15V④
-15V④
-15V FM 1/7G
R48 51.1
R49 51.1
C13 10
C19 10

Figure 6J-6. A16 FM PCB
Schematic Diagram (Sheet 2 of 4)
6700-D-31716-3 (Rev. F)

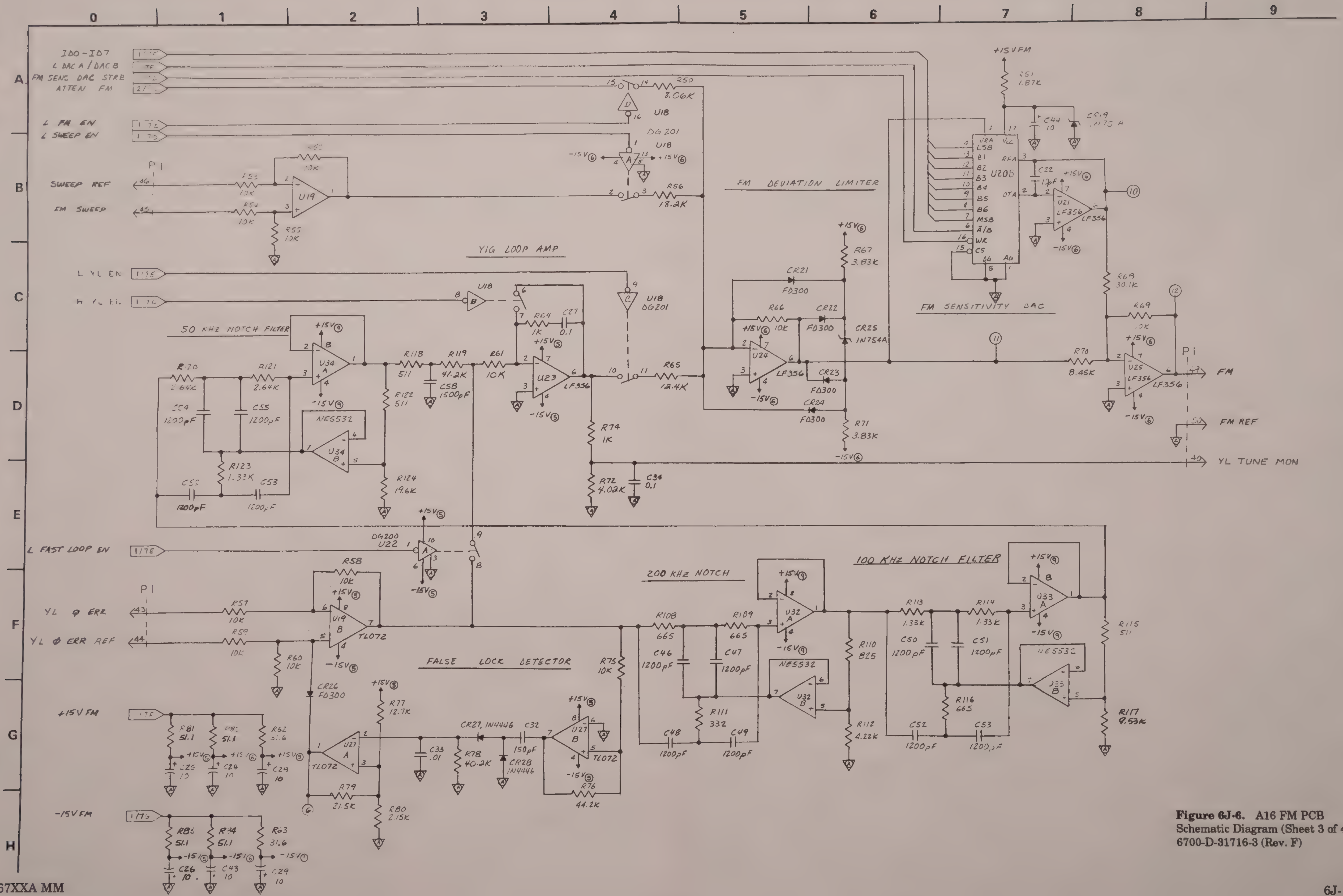

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
ID0-ID7
L DAC A / DAC B
FM SENS DAC STRB
ATTEN FM
L FM EN
L SWEEP EN
SWEEP REF
FM SWEEP
P1
R53 10K
R54 10K
R55 10K
R52 10K
U19
U18
DG201
R50 8.06K
R56 18.2K
+15V⑥
-15V⑥
YIG LOOP AMP
FM DEVIATION LIMITER
FM SENSITIVITY DAC
L YL EN
H YL EN
50 KHz NOTCH FILTER
R120 2.64K
R121 2.64K
C54 1200pF
C55 1200pF
R123 1.33K
C52 1200pF
C53 1200pF
U34 A
U34 B
NE5532
+15V⑨
-15V⑨
R118 511
R119 41.2K
C58 1500pF
R122 511
R124 19.6K
R61 10K
R64 1K
C27 0.1
U23
LF356
+15V⑤
-15V⑤
R65 12.4K
R74 1K
R72 4.02K
C34 0.1
CR21 FD300
R66 10K
CR22 FD300
CR25 IN754A
U24
LF356
CR23 FD300
CR24 FD300
R67 3.83K
R71 3.83K
+15VFM
R51 1.87K
C44 10
CR19 1175 A
U20B
VRA
VCC
LSB
B1
B2
B3
B4
B5
B6
MSB
A/B
WR
CS
DG
AG
RFA
OTA
C22 12pF
U21
LF356
⑩
R68 30.1K
⑫
R69 10K
⑪
R70 8.45K
U25
LF356
FM
FM REF
YL TUNE MON
L FAST LOOP EN
DG200
U22
R58 10K
YL φ ERR
YL φ ERR REF
R57 10K
R59 10K
R60 10K
U19 B
TL072
CR26 FD300
FALSE LOCK DETECTOR
R77 12.7K
U27 A
TL072
R79 21.5K
R80 2.15K
C33 .01
R78 40.2K
CR27, IN4446
C32 150pF
CR28 IN4446
U27 B
TL072
R76 44.2K
R75 10K
200 KHz NOTCH
R108 665
R109 665
C46 1200pF
C47 1200pF
R111 332
C48 1200pF
C49 1200pF
U32 A
U32 B
NE5532
R110 825
R112 4.22K
100 KHz NOTCH FILTER
R113 1.33K
R114 1.33K
C50 1200pF
C51 1200pF
R116 665
C52 1200pF
C53 1200pF
U33 A
U33 B
NE5532
R115 511
R117 9.53K
+15V FM
FB1 51.1
FB2 51.1
R62 31.6
C25 10
C24 10
C28 10
-15V FM
RB3 51.1
R84 51.1
R63 31.6
C26 10
C43 10
C29 10

Figure 6J-6. A16 FM PCB Schematic Diagram (Sheet 3 of 4) 6700-D-31716-3 (Rev. F)

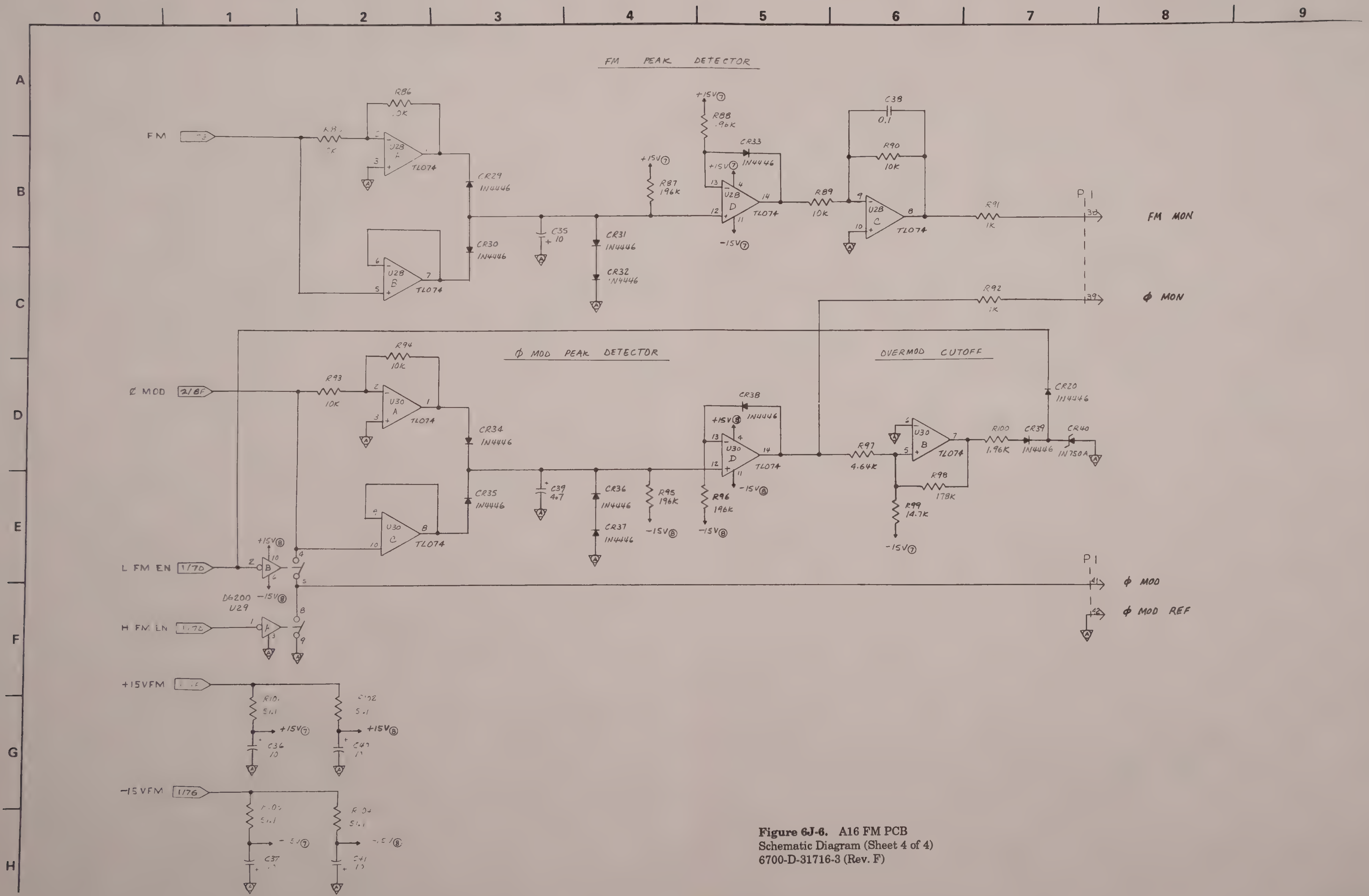
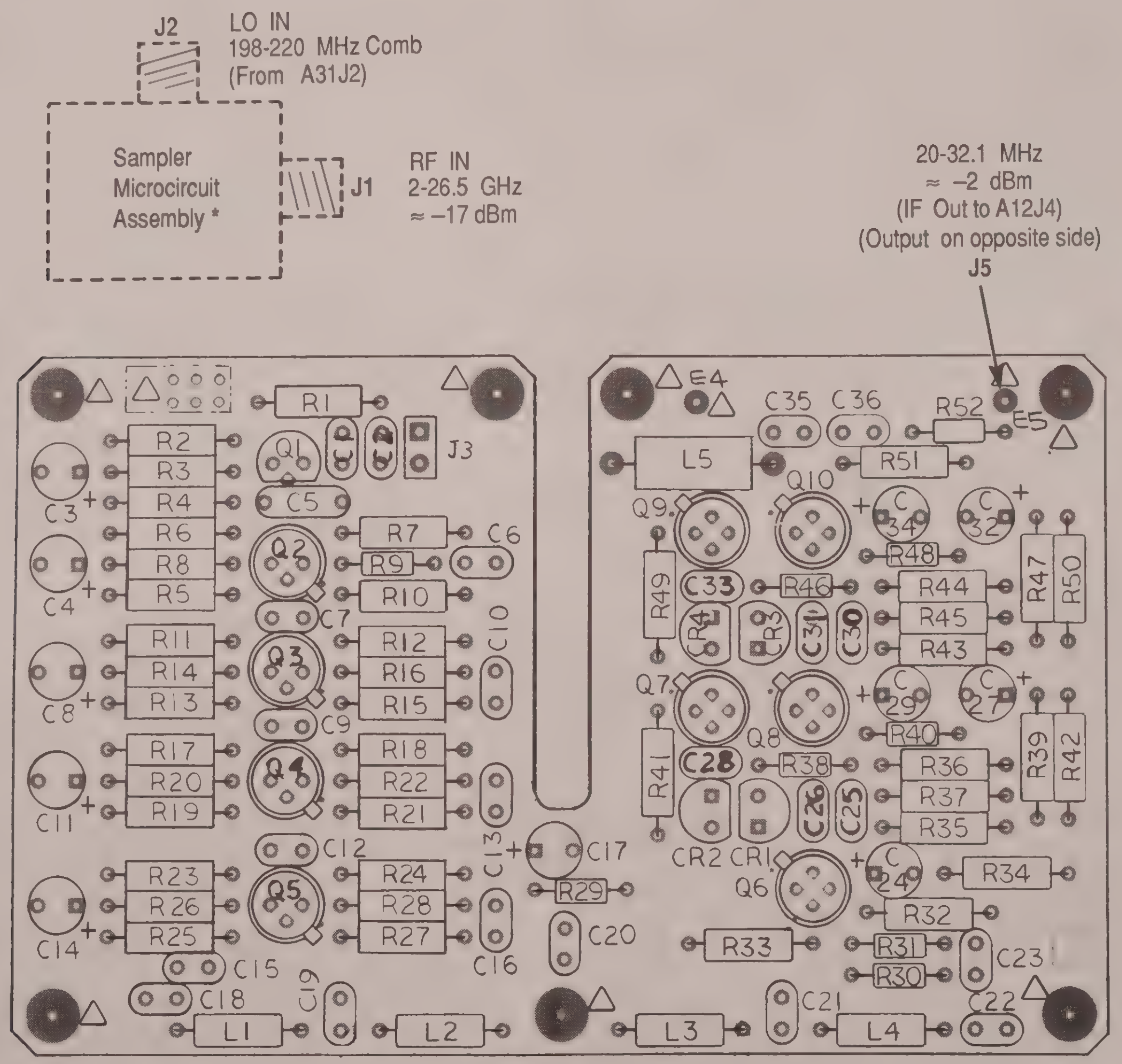
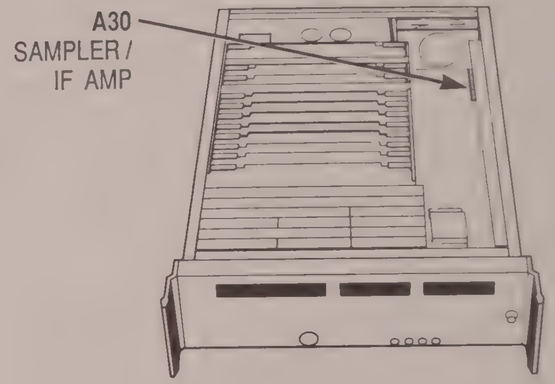

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
FM PEAK DETECTOR
FM
R86
R81
U2B A
TL074
CR29 1N4446
CR30 1N4446
U2B B
TL074
C35 10
CR31 1N4446
CR32 1N4446
+15V⑦
R87 196K
+15V⑦
R88
CR33 1N4446
+15V⑦
U2B D
TL074
-15V⑦
R89 10K
C38 0.1
R90 10K
U2B C
TL074
R91 1K
P1
FM MON
R92 1K
ϕ MON
ϕ MOD PEAK DETECTOR
OVERMOD CUTOFF
ϕ MOD
2/8F
R93 10K
R94 10K
U30 A
TL074
CR34 1N4446
CR35 1N4446
U30 C
TL074
C39 4.7
CR36 1N4446
CR37 1N4446
R95 196K
-15V⑧
R96 196K
-15V⑧
CR38 1N4446
+15V⑧
U30 D
TL074
-15V⑧
R97 4.64K
U30 B
TL074
R98 178K
R99 14.7K
-15V⑦
R100 1.96K
CR39 1N4446
CR20 1N4446
CR40 1N750A
L FM EN
1/70
+15V⑧
-15V⑧
DG200 U29
H FM EN
P1
ϕ MOD
ϕ MOD REF
+15VFM
R101 51.1
+15V⑦
C36 10
R102 51.1
+15V⑧
C40
-15VFM
1/76
R103 51.1
C37
R104 51.1
C41

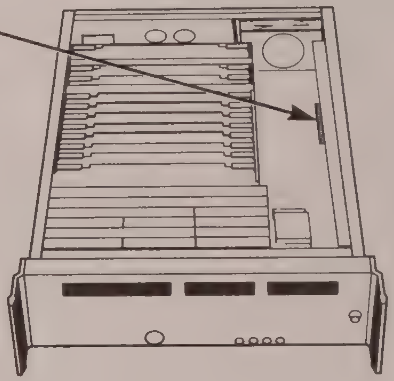
Figure 6J-6. A16 FM PCB
Schematic Diagram (Sheet 4 of 4)
6700-D-31716-3 (Rev. F)

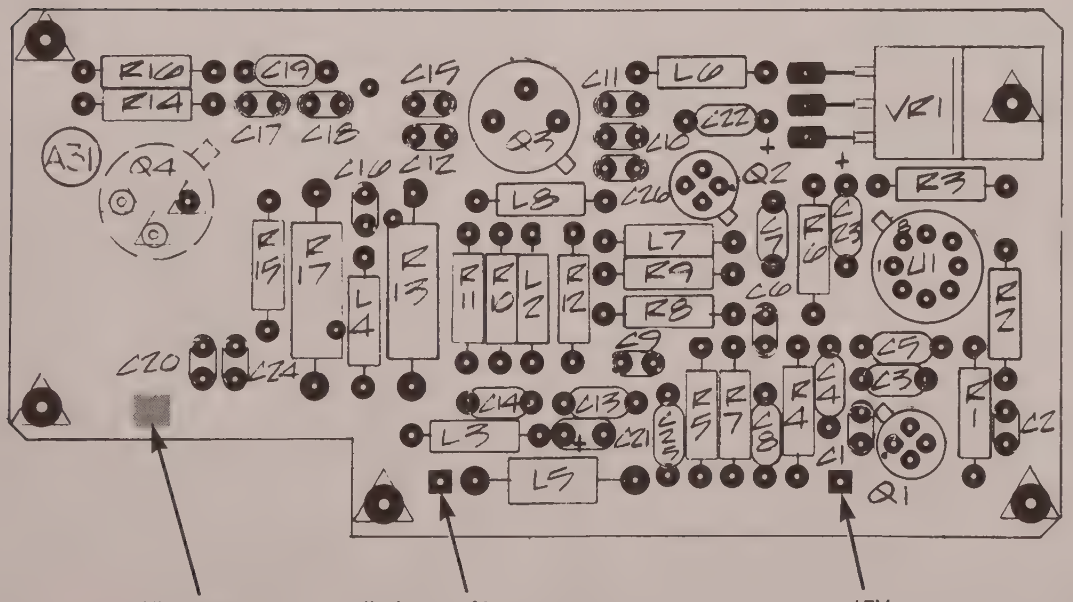

J2
LO IN
198-220 MHz Comb
(From A31J2)
Sampler
Microcircuit
Assembly *
J1
RF IN
2-26.5 GHz
≈ −17 dBm
20-32.1 MHz
≈ −2 dBm
(IF Out to A12J4)
(Output on opposite side)
J5
J3
E4
E5
R1 R2 R3 R4 R6 R8 R5 R7 R9 R10 R11 R14 R13 R12 R16 R15 R17 R20 R19 R18 R22 R21 R23 R26 R25 R24 R28 R27 R29
C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20
Q1 Q2 Q3 Q4 Q5
L1 L2 L3 L4 L5
C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36
R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52
Q6 Q7 Q8 Q9 Q10
CR1 CR2 CR3 CR4


A30
SAMPLER /
IF AMP

* Part of A30 Sampler/IF Amplifier PCB assembly.

Figure 6J-7. A30 Sampler/IF Amplifier PCB Parts Locator Diagram
6700-D-31730-3 (Rev. E)


A31
POWER AMP /
MULTIPLIER

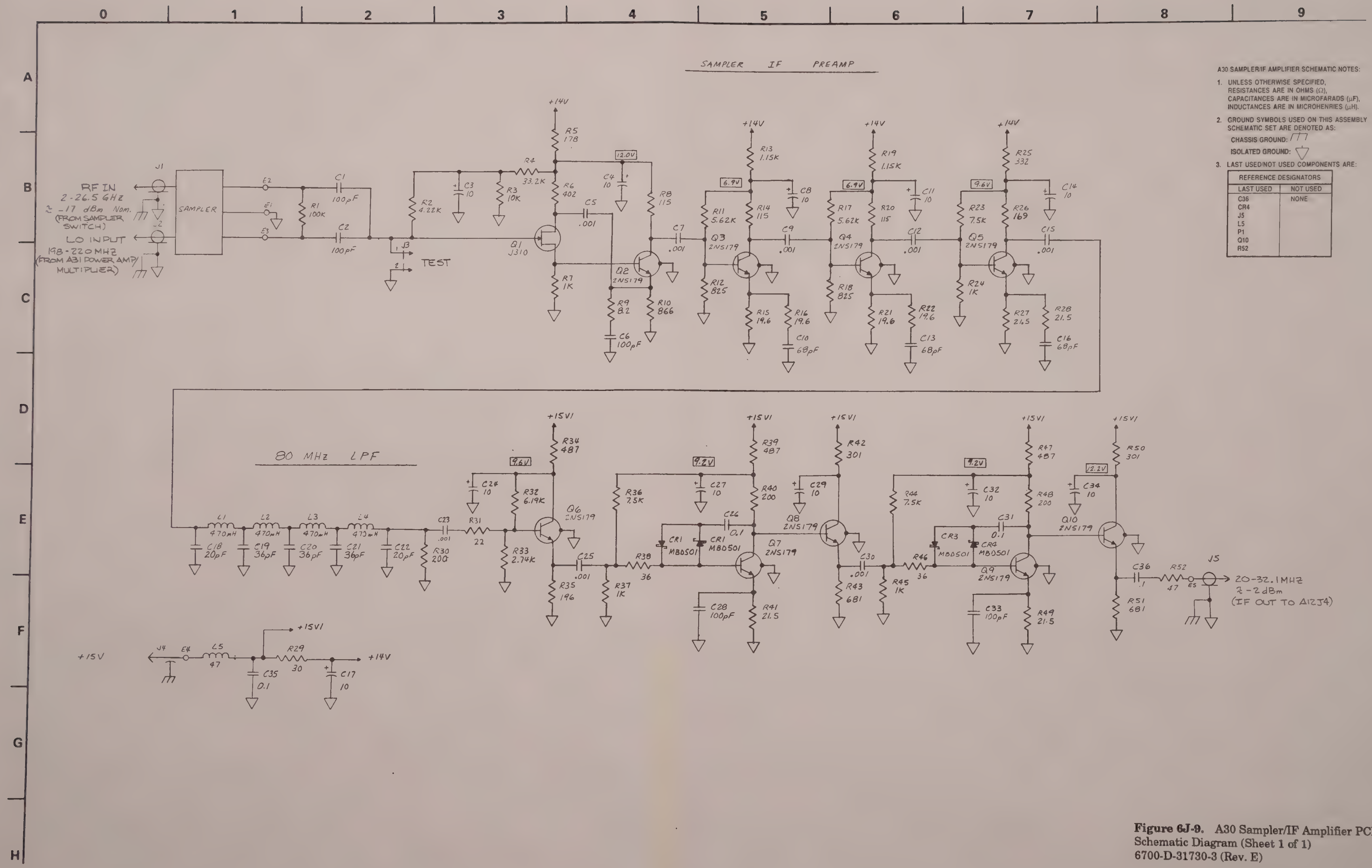

A31
R16
R14
C19
C17
C18
C15
Q4
Q3
C16
C12
C11
L6
C22
C10
VR1
R3
C26
Q2
L8
R15
R17
L4
R13
R11
R10
L2
R12
L7
R9
R8
C7
R6
C23
U1
R2
C6
C9
C20
C24
C14
C13
L3
C21
C25
R5
R7
C8
R4
C4
C5
C3
R1
C2
C1
L5
Q1

The step-recovery diode microcircuit connects at this point (part of connector assembly).

J1
396-440 MHz
≈ −3 dBm
(CL VTO from A4J1)

+15V
Supply Input

Figure 6J-8. A31 Power Amp/Multiplier PCB Parts Locator Diagram
6700-C-18660 (Rev. C)

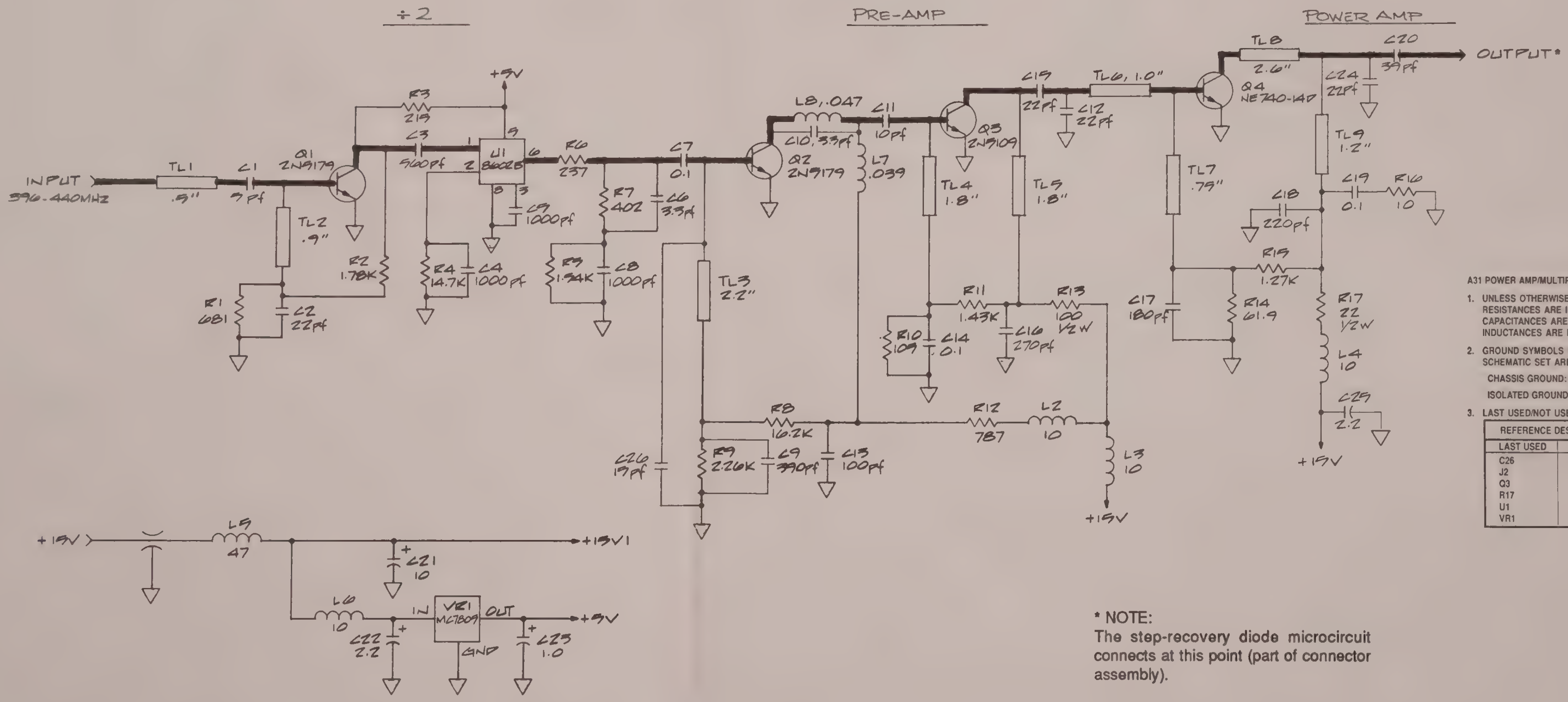

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
SAMPLER IF PREAMP
RF IN
2-26.5 GHz
≈ -17 dBm Nom.
(FROM SAMPLER SWITCH)
LO INPUT
198-220 MHz
(FROM A31 POWER AMP/MULTIPLIER)
J1
J2
SAMPLER
E2
E1
E3
R1 100K
C1 100pF
C2 100pF
J3
TEST
+14V
R5 178
R4 33.2K
R2 4.22K
C3 10
R3 10K
R6 402
C5 .001
Q1 J310
R7 1K
12.0V
C4 10
R8 115
Q2 2N5179
R9 8.2
R10 866
C6 100pF
C7 .001
6.9V
R11 5.62K
R13 1.15K
R14 115
C8 10
Q3 2N5179
R12 825
R15 19.6
R16 19.6
C10 68pF
C9 .001
R17 5.62K
R19 1.15K
R20 115
C11 10
Q4 2N5179
R18 825
R21 19.6
R22 19.6
C13 68pF
C12 .001
9.6V
R23 7.5K
R25 332
R26 169
C14 10
Q5 2N5179
R24 1K
R27 21.5
R28 21.5
C16 68pF
C15 .001
80 MHz LPF
L1 470nH
L2 470nH
L3 470nH
L4 470nH
C18 20pF
C19 36pF
C20 36pF
C21 36pF
C22 20pF
R30 200
C23 .001
R31 22
+15VI
9.6V
C24 10
R32 6.19K
R33 2.74K
R34 487
Q6 2N5179
R35 196
C25 .001
9.2V
R36 7.5K
R37 1K
R38 36
CR1 MBD501
CR1 MBD501
C27 10
C26 0.1
R39 487
R40 200
Q7 2N5179
C28 100pF
R41 21.5
R42 301
C29 10
Q8 2N5179
R43 681
C30 .001
R44 7.5K
R45 1K
R46 36
9.2V
C32 10
C31 0.1
CR3 MBD501
CR4 MBD501
R47 487
R48 200
Q9 2N5179
C33 100pF
R49 21.5
12.2V
R50 301
C34 10
Q10 2N5179
R51 681
C36 .1
R52 47
E5
J5
20-32.1 MHz
≈ -2 dBm
(IF OUT TO A12J4)
+15V
J4
E4
L5 47
C35 0.1
R29 30
+14V
C17 10

A30 SAMPLER/IF AMPLIFIER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   - CHASSIS GROUND:
   - ISOLATED GROUND:
3. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C36 CR4 J5 L5 P1 Q10 R52	NONE

Figure 6J-9. A30 Sampler/IF Amplifier PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31730-3 (Rev. E)


÷ 2
PRE-AMP
POWER AMP
INPUT
396-440MHZ
TL1 .5"
C1 9pf
Q1 2N5179
TL2 .9"
R1 681
C2 22pf
R2 1.78K
R3 215
C3 560pf
+5V
U1 SP8602B
C5 1000pf
R4 14.7K
C4 1000pf
R6 237
R7 402
C6 3.3pf
R5 1.54K
C8 1000pf
C7 0.1
Q2 2N5179
L8, .047
C10, 3.3pf
C11 10pf
L7 .039
TL3 2.2"
C26 15pf
R8 16.2K
R9 2.26K
C9 390pf
C13 100pf
Q3 2N5109
TL4 1.8"
TL5 1.8"
R10 105
C14 0.1
R11 1.43K
C16 270pf
R13 100 1/2W
R12 787
L2 10
L3 10
+15V
C15 22pf
C12 22pf
TL6, 1.0"
TL7 .79"
C17 180pf
R14 61.9
R15 1.27K
Q4 NE740-140
TL8 2.6"
C24 22pf
C20 39pf
OUTPUT*
TL9 1.2"
C18 220pf
C19 0.1
R16 10
R17 22 1/2W
L4 10
C25 2.2
+15V
+15V
L5 47
+15V1
C21 10
L6 10
C22 2.2
VR1 MC7805
IN
OUT
GND
C23 1.0
+5V

A31 POWER AMP/MULTIPLIER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: ⏚
   ISOLATED GROUND: ▽
3. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C26 J2 Q3 R17 U1 VR1	NONE

* NOTE:
The step-recovery diode microcircuit connects at this point (part of connector assembly).

Figure 6J-10. A31 Power Amp/Multiplier PCB Schematic Diagram (Sheet 1 of 1) 6700-C-18660 (Rev. C)

6K– ANALOG INSTRUCTION: A17 PCB

6K-1 ANALOG INSTRUCTION ASSEMBLY: A17 PCB

This section contains service information for the A17 Analog Instruction PCB assembly listed below in Table 6K-1. Refer also to the general reference information in Sections 6A, 6B, and 6C.

6K-2 ANALOG INSTRUCTION ASSEMBLY,

Table 6K-1. Analog Instruction Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6K-2	6K-1
Block Diagram	Fig. 6K-9	6K-19
Troubleshooting	Tbl. 6K-6	6K-17
PCB LEVEL		
A17 Analog Instruction PCB		
General Circuit Descriptions:		
Microprocessor Interface/ Internal Data Bus	Para. 6K-3	6K-2
Ramp Generator	Para. 6K-4	6K-2
±10V Reference Supplies	Para. 6K-5	6K-3
Frequency Instruction	Para. 6K-6	6K-3
Digital Voltmeter (DVM)	Para. 6K-7	6K-4
Power Meter	Para. 6K-8	6K-5
Detailed Circuit Descriptions:		
Microprocessor Interface/ Internal Data Bus	Para. 6K-9	6K-7
Ramp Generator	Para. 6K-10	6K-8
±10V Reference Supplies	Para. 6K-11	6K-11
Frequency Instruction	Para. 6K-12	6K-11
Digital Voltmeter (DVM)	Para. 6K-13	6K-14
Power Meter	Para. 6K-14	6K-15
Troubleshooting	Tbl. 6K-6	6K-17
Parts Locator Diagram	Fig. 6K-10	6K-20
Schematic (Sheet 1 of 4)	Fig. 6K-11	6K-21
(Sheet 2 of 4)	"	6K-23
(Sheet 3 of 4)	"	6K-25
(Sheet 4 of 4)	"	6K-27

OVERALL DESCRIPTION

Refer to the block diagram in Figure 6K-11 for the following discussion.

The Analog Instruction is comprised solely of the A17 Analog Instruction PCB. The A17 PCB controls the analog operations within the 67XXA. Its circuits are divided into the functional groups described below. Although analog, the A17 is entirely under A23 Microprocessor control. Through the use of high-precision analog-to-digital converters (ADCs), digital-to-analog converters (DACs), and operational amplifiers (Op Amps), there are no hardware adjustments required for correct operation.

The A17 Analog Instruction PCB is described in the following parts:

- **Microprocessor Bus Interface and Internal Data Bus** – Separate bus and control lines are used to provide noise immunity.
- **Ramp Generator** – This circuit provides the analog sweep ramp. Additionally, it determines where the bandswitch points and the markers are to be placed.
- **+10V Reference Supplies** – This circuit provides the reference voltages for the DVM circuits.
- **Frequency Instruction** – This circuit has two modes of operation: CW and sweep. In the CW mode, a dc voltage goes to the appropriate YIG driver to coarse tune the YIG for phase-lock operation. In the sweep mode, this circuit adjusts the amplitude of the ramp from the ramp generator circuit. It sums this ramp with the dc CW tune voltage to provide a sweep voltage to the appropriate YIG driver.
- **Digital Voltmeter (DVM)** – The DVM crcuit does the following:
  (1) Monitors the phase-lock loops to determine if the system is phase locked.
  (2) Measures the percentage of AM and FM deviation when the RF output is modulated.
  (3) Monitors various other points in the 67XXA during self-test and calibration routines.
  (4) Interfaces between the A23 Microprocessor and the various analog circuits in the instrument.
- **Power Meter** – The power meter circuit, used in conjunction with a WILTRON 560 series detector (or equivalent), allows measurement of an external RF source—or of the RF output of the 67XXA synthesizer.

6K-3 MICROPROCESSOR INTERFACE AND INTERNAL DATA BUS, GENERAL DESCRIPTION

Refer to the A17 PCB block diagram in Figure 6K-11 for the following discussion.

The A17 PCB is addressed by the A23 Microprocessor PCB with address lines **L PA15** and **L PA19**. These two address lines are assigned *only* to this assembly, whereas the **PA0-PA2** address lines are common to all of the boards on the A23 Microprocessor bus. **L PA15** and **L PA19** actually address a particular latch on the A17 PCB.

L PA15, in conjunction with **PA0-PA2**, addresses only the digital voltmeter, power meter, and band select latches—circuits also addressed directly by the A23 Microprocessor. Addressing the circuits in this manner, provides isolation from the ramp generator and frequency instruction circuits.

L PA19, in conjunction with **PA0-PA2,** addresses the ramp integrator and frequency instruction portions of the A17 PCB. These circuits are buffered from the A23 Microprocessor data bus to provide noise immunity when not being addressed by the microprocessor. This internal data bus is further extended to a 16-bit bus. A 16-bit bus is needed for the circuit's 16- and 12-bit DACs. The second 8-bit bus comes from the DAC LSB (least-significant bit) latch.

The YIG driver select latch selects the YIG oscillator to which the frequency instruction's voltages are to be applied. In addition, it also supplies signals for the following A18-A21 YIG Oscillator PCB circuits:

- The RF Off circuit, which turns off the YIG oscillators (via **L RF OFF**).
- The CW Filter circuit, which switches a filter capacitor across the YIG oscillator's main tuning coil for CW operation and narrow band sweeps.

6K-4 RAMP GENERATOR, GENERAL DESCRIPTION

This circuit consists of parts of the Ramp Control Latch, Sweep Time DAC, Marker-Switch Point DAC, RampMarker-Switch Point Comparator, and Ramp Control Logic, plus the Ramp Integrator itself.

The integrator charges through the integrator capacitor. It does so at a rate determined by the voltage from the Sweep Time DAC applied through a resistor. There are three of these resistors: one for sweep times of ≤1 second, another for sweep times >1 second, and a third for the retrace-to-discharge time. The selection between the two resistors for the sweep time is determined by the front panel setting of the sweep time. The selection of the resistor for the retrace-to-discharge time is determined by the A23 Microprocessor in conjunction with the Ramp Control Logic.

The output of the sweep integrator goes to the Marker-Switch Point Comparator. The other input to the Marker-Switch Point Comparator comes from the Marker-Switch Point DAC. The top (high end) of the ramp is –10V and the bottom (low end) is 0V. With the DAC set at –10V (and with the Sweep Time DAC set so that the ramp charges), as the ramp reaches –10V, the comparator switches states. This change of state triggers the Marker-Switch Point Comparator logic. This logic opens the switch that applies the charging current from the Sweep Time DAC. This sends a dwell interrupt to the A23 Microprocessor.

Upon receiving the dwell interrupt, the A23 Microprocessor interrupts what it is doing and sends an acknowledgement. The ramp then holds at –10V for approximately 20 ms. During this time, the A23 Microprocessor phase locks the RF signal, determines the frequency error, and stores this error-value for later use. When this is accomplished, the A23 Microprocessor PCB:

- Turns off the RF OUTPUT power
- Sets the blanking and sequential sweep signals on the A29 Rear Panel Interface PCB
- Turns off the automatic level control (ALC).

After the A23 Microprocessor completes its top-of-the-ramp tasks, it does the following:

- It tells the Ramp Control Logic to close the switch that discharges the integrator capacitor to 0V.
- It sets the Marker-Switch Point DAC to 0V. This releases the dwell and allows the ramp to start towards 0V.

During this ramp discharge (retrace) of approximately 30 ms, the A23 Microprocessor:

- Calculates the errors for the correction of the frequency on the next setup, and
- Prepares the phase lock loops to lock at the bottom of the sweep.

When the ramp reaches 0V, the Marker-Switch Point Comparator changes states again. This tells the Ramp Control Logic to open the discharge current switch. The A23 Microprocessor then phase locks the RF at the new frequency and adds any correction value that was calculated during retrace. It then turns the RF on via the ALC board and changes the state of the blanking and sequential sync signal via the A29 Rear Panel Interface PCB. Everything is allowed to settle for a few milliseconds, then the dwell is released and the ramp starts on it way to –10V again.

If, during the sweep, oscillators have to be bandswitched, the Marker-Switch Point DAC is set to the calculated voltage for this bandswitch instead of the –10V value. During this bandswitch dwell, the A23 Microprocessor will lock the previous oscillator that was sweeping and determine the error, if any, then turn it off. After so doing, it:

- Turns on the next oscillator.
- Phase-locks it, and determines the frequency error, if any.
- Sets the Marker-Switch Point DAC for the next dwell point.
- Clears the dwell and sends the ramp to –10V.

If a frequency marker within the sweep range of the sweep has been selected, the voltage at which this marker is to occur is programmed into the Marker-Switch Point DAC. When the ramp reaches this voltage, the Marker-Switch Point Comparator output changes states and the sweep again dwells. However, during this dwell, the frequency is not phase locked as at the other dwell points. If the VIDEO marker is selected, there will be a 5 volt pulse from the rear panel interface applied to the rear panel during this time.

The integrator ramp is also buffered and amplified, then applied to the frequency instruction circuits as a –10V to +10V ΔF ramp. It is buffered and inverted and sent through the A29 Rear Panel Interface PCB to the HORIZ OUTPUT BNC connector.

6K-5 ±10V REFENCE SUPPLIES, GENERAL DESCRIPTION

There are four reference supplies on the A17 Analog Instruction PCB:

- +10V REF T
- –10V REF T
- +10V REF 2
- –10V REF 2

The ±10V REF T supplies are used for reference for the ramp generator and frequency instruction circuits. They also supply +10V REF T to the A18-A21 YIG Driver PCBs and a +10V REF to the A29 Rear Panel Interface. The ±10V REF 2 references supply reference voltages for the DVM and power meter circuits.

6K-6 FREQUENCY INSTRUCTION, GENERAL DESCRIPTION

These circuits provide the analog tuning voltages for the A18-A21 YIG Driver PCBs in both the CW and swept operational modes.

In the CW mode of operation, a dc voltage from the 16-bit Tune DAC is applied to the YIG Driver PCBs. When the +10V reference is switched to the Tune DAC, the DAC has a range of 0V to –10V. Conversely, when the –10V reference is switched to the Tune DAC, the DAC has a range of 0V to +10V. To allow for circuit tolerances, the actual voltage applied to the YIG Driver PCB is approximately –1V at the low end and –9V at the high end of the YIG tuning range. This provides approximately 50,000 steps of tuning for each oscillator (of the 65,536 available in the Tune DAC).

Example: For a 2-8 GHz YIG oscillator, 2 GHz occurs at approximately –1V and 8 GHz occurs at approximately –9V. With 50,000 steps, this results in 120 kHz/step resolution (8 GHz – 2 GHz = 6 GHz; 6 GHz/50,000 steps = 120 kHz/step). This 120 kHz resolution is further improved by the phase lock loops, which have a 1 kHz resolution.

The 8V range (9V–1V=8V) results in a voltage step of 160 μV (8V/50,000=0.000160V) for the above example.

This –1V and –9V may vary as much as 10%, depending on the YIG oscillator and its driver. However, a particular YIG driver/YIG oscillator for the

2-8 GHz band will be the same whether it is used in a 2-20 GHz unit, a 10 MHz-26.5 GHz unit, or a 2-8 GHz unit.

Table 6K-2. Oscillator Bandswitch Voltages

OSCILLATOR	LOW END VOLTAGE (VOLTS)	HIGH END VOLTAGE (VOLTS)	FREQUENCY RESOLUTION (KHz)	VOLTAGE RESOLUTION (MICROVOLTS)
2-8 GHz	-1V	-9V	120	160
2-8.4 GHz	-1V	-9V	128	160
8-12.4 GHz	-1V	-9V	88	160
12.4-20 GHz	-1V	-9V	152	160
13.25-20 GHz	-1V	-9V	135	160
18-26.5 GHz	-1V	-9V	170	160
20-26.5 GHz	-1V	-9V	130	160

The actual voltages for each YIG driver are stored as a DAC word in non-volatile memory at the time of frequency calibration. These calibration voltages are used in all of the A23 Microprocessor calculations for analog sweep, stepped sweep and CW frequencies. Table 6K-2 shows the most commonly used YIG frequency bands in the 67XXA.

YIG oscillators have a typical linearity of 0.05%. At higher frequencies, this can lead to significant error (≈13 MHz @ 20-26 GHz). Although not so important in CW or stepped sweep modes, this error this can lead to significant inaccuracies in an analog sweep. The error is reduced with the use of a Linearity DAC.

The frequency instruction output to the A18-A21 YIG Driver PCBs is also applied to the Linearity DAC circuit. The output of this circuit, which is used to reduce the linearity errors, is fed back to the input of the output buffer amplifier as either a positive or negative voltage. Both the breakpoint and the magnitude of this voltage are programmable. The voltage is stored for each YIG band at the time of frequency calibration. Figure 6K-1 shows a typical YIG frequency versus tuning current curve as the "A" graph. Graph "B" shows the curve after correction by the Linearity DAC.

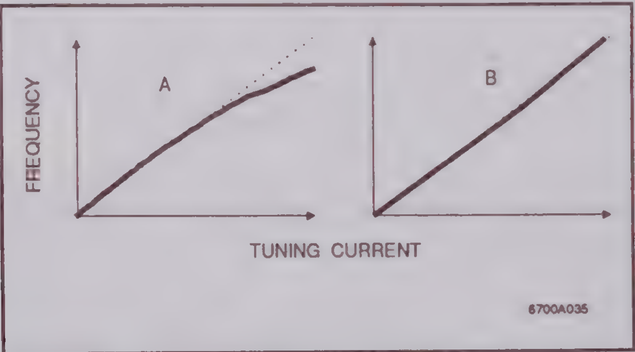


Figure 6K-1. Frequency-vs-Tuning Current Graph

The Sweep Width DAC receives a +10V to –10V ramp from the ramp generator and attenuates it according to the selected sweep width. When sweeping a single YIG oscillator, the Sweep Width DAC attenuates the 20V peak-to-peak ramp down to the 8V peak-to-peak swing required for the YIG driver. Since the attenuated ramp goes from –4V to +4V the Tune DAC sums a –5V offset with the attenuated ΔF ramp to provide the necessary –1V to –9V tuning range for the YIG. (The Sweep Width DAC inverts the ΔF ramp, and the summing amplifier inverts the input signals.)

When broadband sweeps are selected—such as 2-20 GHz—the slope of the ΔF ramp is insufficient to cover the frequency range of each of the YIG oscillators used. In this case, the gain of the summing amplifier is switched to provide a gain of four for both the ramp voltage and the Tune DAC voltage. This allows the Sweep Width DAC to still attenuate.

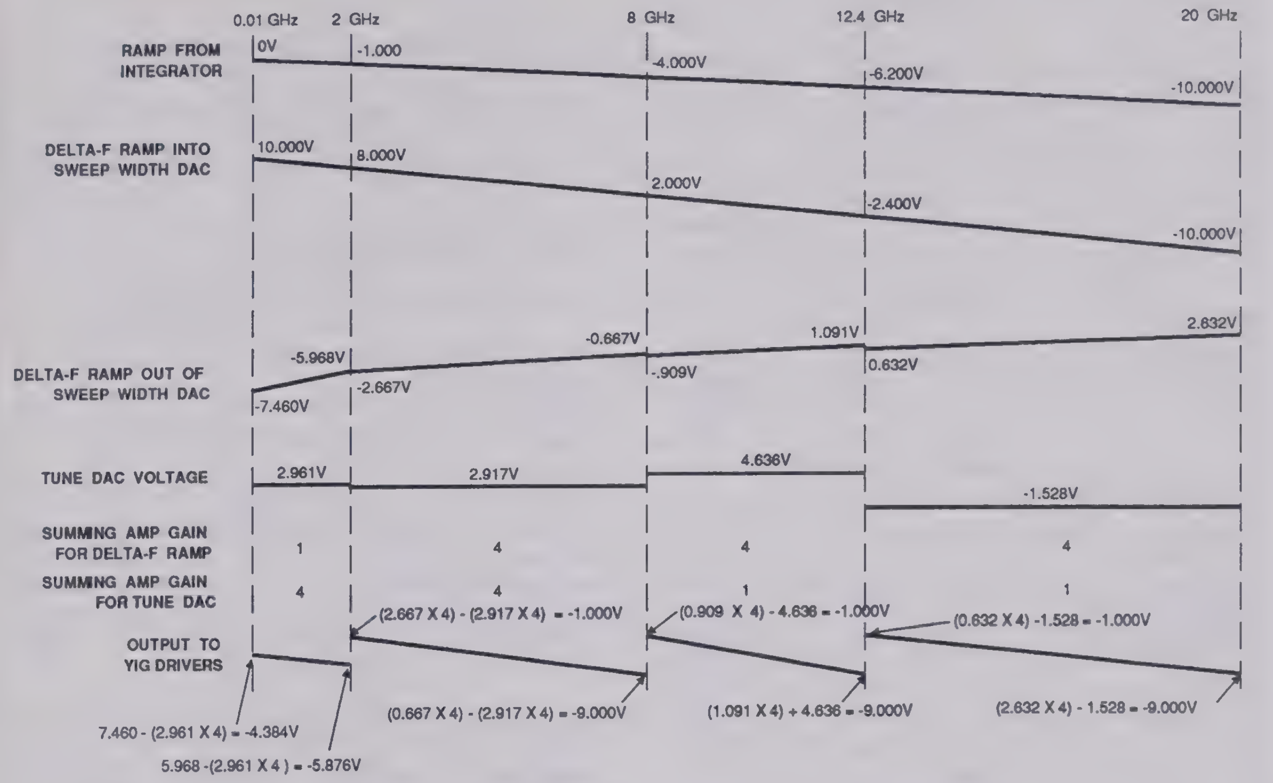
Figure 6K-2 shows the relationship of the ΔF ramp, Sweep Width DAC attenuation settings, and Tune DAC voltage required for a typical broadband sweep.

In narrow band sweeps (<50 MHz), the output of the Sweep Width DAC does not go to the summing amplifier. The ΔF ramp is then applied to the A16 FM PCB, where it sweeps the FM coil of the YIG oscillator. The Tune DAC is set to the center frequency of the narrow band sweep and the CW filter (located across the main tuning coil) is enabled. The FM sweep DAC provides reduced residual FM and improved resolution for the narrow band sweeps.

6K-7 DIGITAL VOLTMETER (DVM), GENERAL DESCRIPTION

The digital voltmeter circuit consists of a 12-bit analog-to-digital converter (ADC), a 24 channel multiplexer, and a sample/hold network. It has a +10V to –10V basic range and two auto ranges of ±20V and ±100V.

The three 8-to-1 multiplexers are addressed by the DVM and Multiplexer (Mux) Control Latch to select which channel is to be measured. This voltage then goes to a sample/hold circuit. This circuit holds this


0.01 GHz
2 GHz
8 GHz
12.4 GHz
20 GHz
RAMP FROM INTEGRATOR
0V
-1.000
-4.000V
-6.200V
-10.000V
DELTA-F RAMP INTO SWEEP WIDTH DAC
10.000V
8.000V
2.000V
-2.400V
-10.000V
DELTA-F RAMP OUT OF SWEEP WIDTH DAC
-5.968V
-7.460V
-2.667V
-0.667V
-.909V
1.091V
0.632V
2.632V
TUNE DAC VOLTAGE
2.961V
2.917V
4.636V
-1.528V
SUMMING AMP GAIN FOR DELTA-F RAMP
1
4
4
4
SUMMING AMP GAIN FOR TUNE DAC
4
4
1
1
OUTPUT TO YIG DRIVERS
(2.667 X 4) - (2.917 X 4) = -1.000V
(0.909 X 4) - 4.636 = -1.000V
(0.632 X 4) -1.528 = -1.000V
(0.667 X 4) - (2.917 X 4) = -9.000V
(1.091 X 4) + 4.636 = -9.000V
(2.632 X 4) - 1.528 = -9.000V
7.460 - (2.961 X 4) = -4.384V
5.968 -(2.961 X 4) = -5.876V

NOTES:
1. The tuning voltages, -1V & -9V, are typical tuning voltages for the yigs and will vary from one yig to another.
2. The voltages given are rounded off to the nearest millivolt.
3. The above figure is for a typical 6747A. Other models will vary as far as switchpoint voltages and dac settings.
4. These voltages and gain settings will also depend on the sweep width and center frequency settings.

6700A036

Figure 6K-2. DVM Channels and Functions

voltage during the conversion of the ADC to provide noise immunity.

The A23 Microprocessor accesses the A17 PCB's DVM at least once every 50 ms as a function of its housekeeping routines. Additionally, when certain operations are in progress — such as during phase locking — the microprocessor accesses the DVM more frequently. The maximum conversion time for the ADC is 30 µs.

Table 6K-3 shows the DVM channels and their basic functions.

6K-8 POWER METER, GENERAL DESCRIPTION

The power meter circuit in conjunction with a WILTRON 560-Series detector is used to measure power from either an external RF source or of the 67XXA itself. It consists of the following:

- A buffer amplifier for the temperature compensating thermistor, located in the detector head.
- A buffer amplifier for measuring the calibration offset, also located in the detector head.
- An amplifier/synchronous detector for the diode voltage.

The input Chopper Amplifier chops the dc signal from the detector at about a 10 Hz rate. This ac signal is then applied to the Programmable

Table 6K-3. DVM Channels and Their Functions

Multiplexer Inputs	*Monitor Lines (to DVM)*	*Monitor Functions*
	Reference Loop	Measures the phase lock conditions of the reference loop from A7 .
	Course Loop	Measures the phase-lock condition of the coarse loop from A6.
	Fine Loop	Measures the phase-lock condition of the fine loop from A11
	Knob	Measures the dc voltage from the A2 PCB DECREASE INCREASE knob circuit. (the control is on the from panel .)
	YIG Loop	Measures the phase-lock condition of the YIG loop from A12.
Frequency Mod Phase Mode	FM/PM	Measures the FM deviation from A16 for display on the front panel MODULATION/TIME display.
	PS1 PS2	Measures the status of the regulated power supplies on the A22 Regulator PCB.
Band 0 Det Therm Band 1-4 Det Therm 10V Reference AM Peak AM Through Detector Shaper Slope	ALC1 ALC2	Measures the thermistor voltages of the leveling detectors for temperature compensation. Measures the reference supplies for self test. Measures the AM for display on the MODULATION/TIME display Measures the detector shaper and slope for use in calibration and test. All of these signals come from the A15 PCB.
	Pulse	Used for self test of the A13 PCB Pulse Generator.
	DVM	Connect to analog ground. Used to zero the DVM.
	Fine Loop Tune	Monitors the tuning voltage of the fine loop oscillators from A9.
	Coarse Loop Tune	Monitors the tuning voltage of the coarse loop oscillators from A4
	Reference Loop Tune	Monitors the tuning voltage of the reference loop oscillators from A5 for calibration and test
	YIG Loop Tune	Monitors the YIG loop phase-lock error from the A12 PCB. Used in the Analog Sweep mode.
	Detector Thermistor	Monitors the thermistor in the power meter head (Series 560 Detector) From the external detector.
	Power Meter	Monitors the output of the power meter ircuit on the A17 PCB for display on the MODULATION/TIME display.
	+10V T	Monitors the reference voltage from the A17 PCB for selt test purposes.
	Tune	Monitors the Tune DAC output from the A17 PCB that goes to the YIG drivers
	DVM	Use as a digital voltmetere for calibration and troubleshooting.

Amplifier, a switched gain amplifier, for amplification. The gain of this amplifier ranges from 10,000 at low signal levels to 1 at high signal levels.

Following amplification, the ac signal goes to the Synchronous Detector. This detector converts the signal back to a suitable dc voltage for measurement by the DVM. This chopper/synchronous detector system minimizes dc offset and drift errors at low signal levels.

6K-9 MICROPROCESSOR BUS INTERFACE AND INTERNAL DATA BUS, DETAILED CIRCUIT DESCRIPTIONS

Refer to the A17 Analog Instruction PCB schematic set for the following discussion.

Shown on sheet 1 of the schematic set are the A23 Microprocessor PCB's data bus lines — **D0-D7**. They are connected directly to U1, U2, U3, U16, and U40. The A23 Microprocessor PCB's address bus lines **PA0**, **PA1**, and **PA2** — are connected directly to U14 and U17.

U1 and U16 are 8-bit, D-type flip-flops with a clear function. Data is first put on the inputs then latched in with the low to high transistion of the strobe from the 3-to-8 decoder U14. The clear, or master reset (MR), is tied thru RN1 to +5V and thru C10 to ground. At power on, the MR is at 0V which sets the output of U1 and U16 to a low state. After about 10 ms, U1 and U16 may then be written to by the A23 Microprocessor. This prevents the YIG Driver select lines from going to a low state and turning on all of the YIG oscillators at the same time during power on. It also disables U3, the DVM, from accessing the A23 Microprocessor bus at the critical power on condition.

U1 controls analog multiplexers U7, U9, and U13, and the DVM, which is a 12-bit analog-to-digital converter. U40 is used to control operation of the power meter circuit. It is an 8-bit, edge-triggered latch with the oututs enabled at all times by the ground at pin 1. The ouputs will change only on the low to high transition of the strobe applied to pin 11. U16 provides the band selects for the YIG oscillators, the CW filter, RF OFF functions, and ranging for the DVM circuit. U2 is the latch for the internal data bus. It is an 8-bit, D-type transparent latch with tri-state outputs. As long as the enable intput on pin 11 is high, the outputs will follow the inputs. This internal data bus provides isolation of the A23 Microprocessor bus from the sensitive DAC's located in the ramp generator and frequency instruction circuits.

U14 and U17 3-to-8 decoders are used to decode the A23 Microprocessor's **PA0-PA2** address information. They also provide a strobe pulse to the various latches and DAC's having their own built-in latches to latch the data from the data bus. The **PA0**, **PA1**, and **PA2** logic signals are applied to pins 1, 2, and 3 respectively. When the **L PA15** signal for U14 or the **L PA19** signal for U17 goes low, the three inputs will be decoded to one of the 8 outputs. This "strobe", about 400 ns wide, will then latch the data on the A23 Microprocessor data bus to the appropriate latch on the A17 PCB.

The internal data bus from transparent latch U2 is connected to the 8-bit latches U8, U11, and DAC's U18, U24, U34, U38, U42.

U18, and U24 are 12-bit DAC's; U34 and U38 are 16-bit DAC's. These 4 and 8 extra bits are obtained with the U8 latch. The least significant nibble (in the case of the 12-bit DACs) or least significant byte (in the case of the 16-bit DACs) is first loaded into U8 latch by U2 latch. Then, the next 8 bits are put on the internal data bus by U2. The appropriate DAC is then strobed to latch the 12 or 16 data bits into the internal latches of the DAC.

The parallel loading of the 12 or 16 bits eliminates the "glitching" of the DAC's that would occur by loading the first byte and then the second byte into the DAC itself.

Ull latch is the ramp and frequency instruction control latch. Both U8 and U11 latches are referenced to "T" ground and have the 5V supplied from R57, C30, CR11 Zener diode supply. This provides further isolation of the circuits that they feed from the A23 Microprocessor bus and the 5V digital power supply.

6K-10 RAMP GENERATOR CIRCUITS, DETAILED CIRCUIT DESCRIPTIONS

The Ramp Generator circuits, shown on sheet 2 of the schematic set, are described in the following subgroups:

- Ramp Integrator
- Marker Switch Point DAC
- Marker Switch Point Comparator
- Ramp Control Logic

6K-10.1 Ramp Integrator

The ramp integrator is comprised of U18, U19, and U20 with their associated components. U18 is a 12-bit DAC (4096 point resolution). It supplies current to U19A. Bits 0-4 are first latched into U8, then bits 5-11 are put on the internal data bus through the U2 transparent latch. The W1, W2, and XFR lines, which are tied together, are brought low for about 400 ns. This transfers the 12 bits of data to the internal latches of U18; the output of U18 will then change.

Since the maximum output of U19A is +10V, R20 and R21 have a 1% tolerance and C14 has a 10% tolerance The actual output voltage of U19A will vary from one unit to the next. This tolerance build-up is handled through software calibration correction values. The typical output of U19A at a 30 ms sweep speed will be approximately +8V. At a sweep speed of 999 ms, this voltage will approach 0V.

The output of U19A is applied to pin 3 of analog switch U20A. This switch is closed for a forward ramp and open for retrace or dwell. From pin 2 of U20A, the voltage is applied to R20. At the junction of R20 and R21, a current through R19 and pins 6 and 7 of U20B from −10V is summed in during retrace of the ramp. R21 is in series with R20 from the 1s to 99s sweep speed range. At sweep speeds less than 1s, R21 is shorted by pins 10 & 11 of the U20C analog switch. From the junction of R20 and pin 10 of U20C, the U19A output voltage/R20 current is applied to U19B. U19B output will charge C14. Since U19B has a typical gain of 200,000, this produces a very linear ramp. See Figure 6K-3 for U19 switch conditions in relation to the ramp.

When the ramp generator is not being used, U20D pins 14 and 15 will be closed — shunting C14 with R22. This prevents the output of U19B from going to the supply rails when not being used.

6K-10.2 Marker-Switch Point DAC

Also shown on sheet 2 of the schematic set are U24 and U25 which comprise the Marker-Switch Point DAC circuit. Operation of this circuit is the same as the Sweep Time DAC, U18.

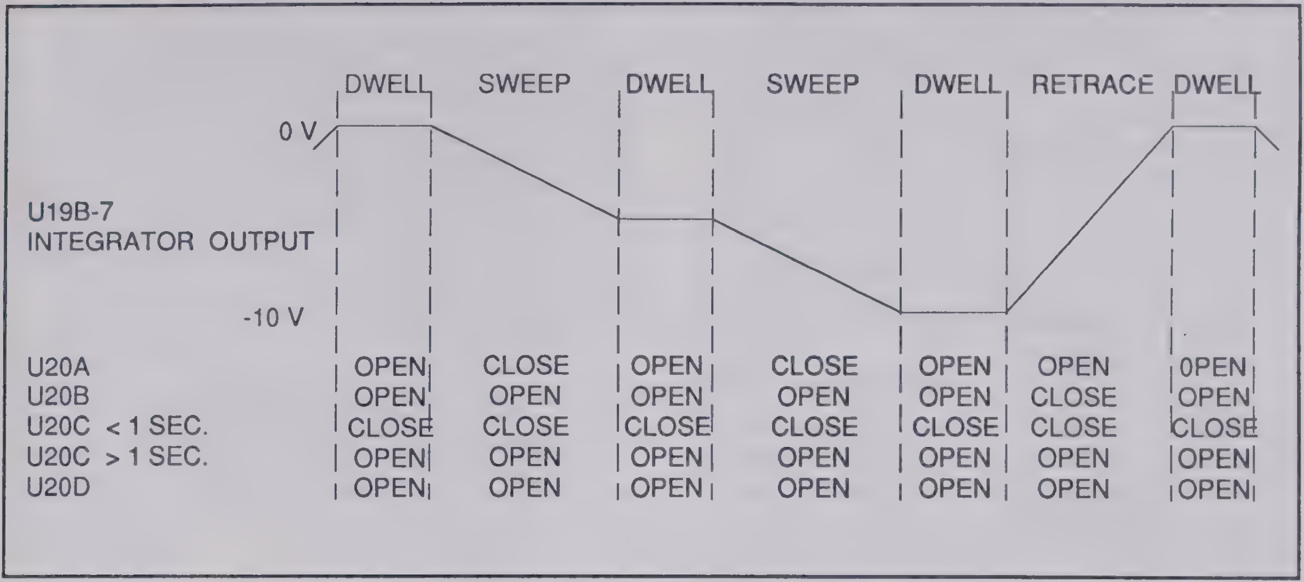
U25 has an additional resistor R32 in the feedback not found in the U18-U19 DAC circuit. The output of the DAC without this resistor will always be about 25 mV less then −10V. R32 calibrates the output to be within typically 3 mV at full scale. U25-6 output, which goes from 0V to −10V, is applied to the Switch Point Comparator which consists of U26 and U27.

6K-10.3 Marker-Switch Point Comparator

The Marker-Switch Point Comparator, U26 and U27, in conjuction with the Marker-Switch Point DAC, U24 and U25, provide a logic signal to the ramp control logic which starts the "dwell." This dwell occurs at the top and bottom of the ramp, at each bandswitch point (for multiband units), and at each selected marker. At the bandswitch dwell, oscillators are switched and phase locked. At a marker, the ramp is only held in the dwell condition for a short time to give an intensity indication when used with an oscilloscope or network analyzer. At the top and bottom ramp dwells, the direction of the ramp is changed.

U26 is a very low input-offset operational amplifier that provide precise comparison between the Marker-Switch Point DAC output and the Ramp Integrator output. This inaccuracy is in the microvolt range. However, U26 is relatively slow, so the output swing is limited from +0.6V to −0.6V from the input voltage at pin 3 by CR4 and CR5. U26 pin 6 is applied to U27 pin 2 and compared again with the U25 pin 6 output. Since the output of U26 swings through the comparison voltage of U25 very quickly in comparison with the ramp voltage, the error due to the typical 3 mV offset of U27 is eliminated.

Figure 6K-4 shows the relationship of the voltages for the comparator circuit. Waveform B shows the output of the Marker-Switch Point DAC. At T2, this voltage is −5V. The solid line in Waveform C shows that the output of U26 is −5.6V. As the ramp voltage from U19B integrator reaches −5V, U26 output goes from −5.6V to −4.4V. This voltage is compared with the −5V on pin 3 of U27. As the voltage at pin 2 reaches −5V, the open collector output U27 pin 7 is pulled to a TTL high by RN1 (The dashed line in



	DWELL	SWEEP	DWELL	SWEEP	DWELL	RETRACE	DWELL
U20A	OPEN	CLOSE	OPEN	CLOSE	OPEN	OPEN	OPEN
U20B	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSE	OPEN
U20C < 1 SEC.	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE
U20C > 1 SEC.	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
U20D	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN

Figure 6K-3. A17U19 Switch Conditions (Relative to Sweep Ramp)

wavefom C represents the voltage at U27 pin 3 and U26 pin 3. The solid line, the voltage at U26 pin 2 and U27 pin 2).

At time T3 on waveform C, with the sweep ramp still at –5V, the output of the Marker-Switch Point DAC is set to –10V. The voltage at U26 pin 6 then goes from –4.4V to –10.6V and U27 pin 7 returns to a TTL low. The dwell is released and the ramp heads toward –10V.

6K-10.4 Ramp Control Logic

The Ramp Control Logic circuits control when the ramp is in the sweep, retrace, or dwell mode. The dwell signal from U27 pin 7 or **L SWP DWELL** from the rear panel BNC connector determines the start of each dwell. All other control signals and timing are determined by the A23 Microprocessor PCB. **L DWELL EN** enables the dwell signal from U27 pin 7, **CLR DWELL STRB** terminates the dwell, and **L RETRACE** determines if the ramp is sweeping or retracing.

Figure 6K-4 also shows the sequence of events for a typical sweep. The dwell at –5V could be either a marker or bandswitch dwell. The dwells at the bottom (0V) and top (–10V) of the ramp are on all cases of a sweep.

Just before T0, the ramp is retracing. Dwell is enabled (waveform G), and Retrace is high (waveform E). As the ramp reaches 0V, the output of U27 pin 7 switches from a high to a low (waveform D). The transition causes the output of U6 pin 11 (waveform F) to go high, U6 pin 8 to go low (waveform H), and triggers U5 pin 11 flip-flop to go low (waveform J). The output of U5 pin 11 is inverted by U4E and sent to the A23 Microprocessor as an interupt. The output of U5 pin 11 is also applied to U23 pin 2. From U23 pin 3, it is inverted by U4C and applied to U23 pin 4 and U23 pin 9. Since **L RETRACE** is true, there will be no change in the output of U23 pin 6, but the output of U23 pin 8, which was low, will now go high. This will open the U20B analog switch supplying integrator current for the retrace. The output of the integrator will now be at 0V and will remain there for the duration of the dwell.

Approximately 100 µs after T0, the A23 Microprocessor sets the **L DWELL EN** high. Since U6 pin 6 and U6 pin 11 are each a open-collector wired-or configuration, the high **L DWELL EN** signal will cause U6 pin 6 to go low to the condition that it was in prior to T0. During the rest of the dwell, from T0 to T1, the processor performs various tasks such as setting the frequency instruction DAC's to their proper outputs, phase locking the RF signal, checking for any frequency error, and turning RF on in preparation to resume sweeping.

At T1, the A23 Microprocessor sets the Marker-Switch Point DAC to the value for the next dwell. This value will depend on the 67XXA model, sweep width, and marker settings. The **CLR DWELL**

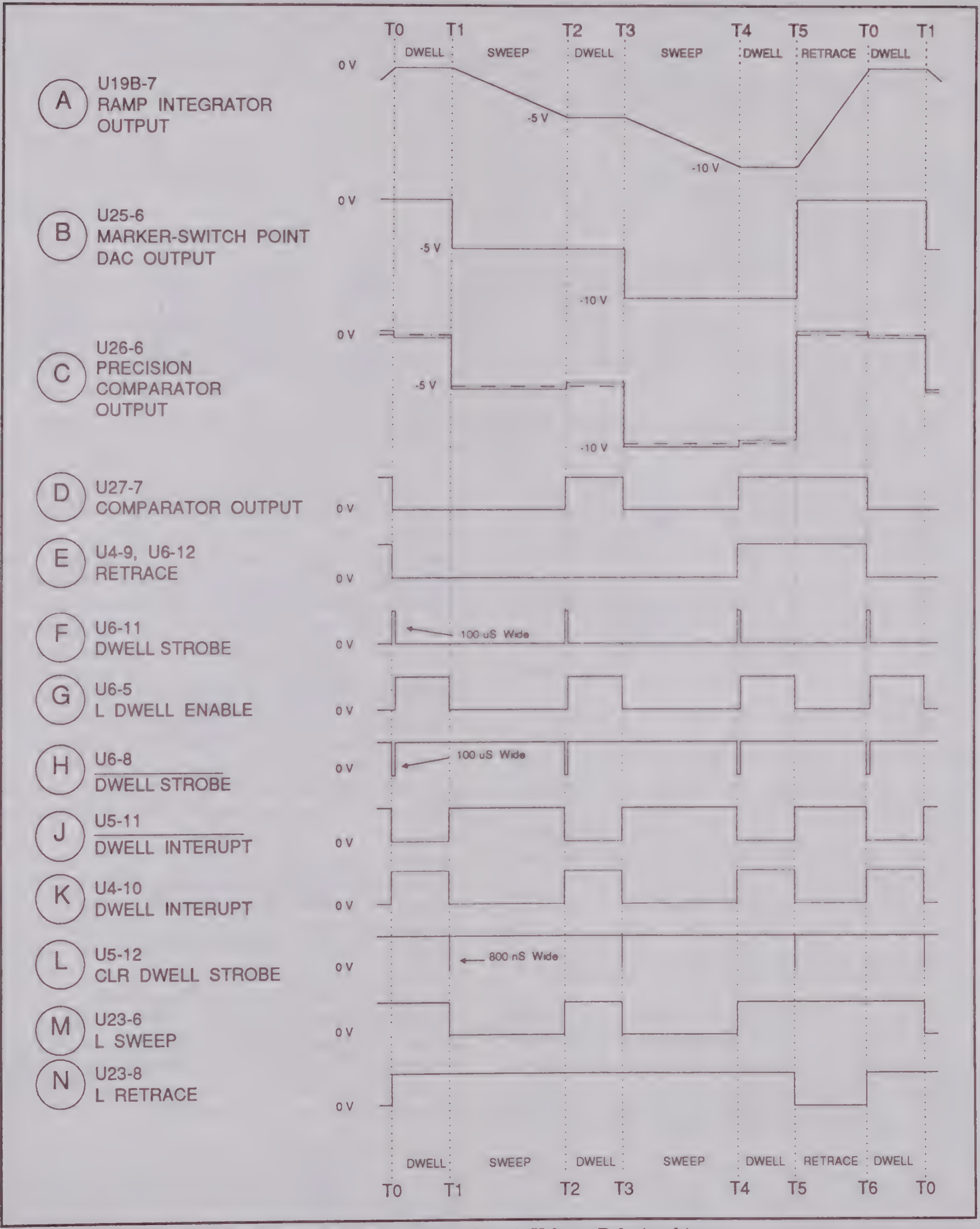

T0 T1 T2 T3 T4 T5 T0 T1
DWELL SWEEP DWELL SWEEP DWELL RETRACE DWELL
A U19B-7 RAMP INTEGRATOR OUTPUT
0 V
-5 V
-10 V
B U25-6 MARKER-SWITCH POINT DAC OUTPUT
0 V
-5 V
-10 V
C U26-6 PRECISION COMPARATOR OUTPUT
0 V
-5 V
-10 V
D U27-7 COMPARATOR OUTPUT
0 V
E U4-9, U6-12 RETRACE
0 V
F U6-11 DWELL STROBE
0 V
100 uS Wide
G U6-5 L DWELL ENABLE
0 V
H U6-8 DWELL STROBE
0 V
100 uS Wide
J U5-11 DWELL INTERUPT
0 V
K U4-10 DWELL INTERUPT
0 V
L U5-12 CLR DWELL STROBE
0 V
800 nS Wide
M U23-6 L SWEEP
0 V
N U23-8 L RETRACE
0 V
DWELL SWEEP DWELL SWEEP DWELL RETRACE DWELL
T0 T1 T2 T3 T4 T5 T6 T0

Figure 6K-4. Comparator Circuit Voltage Relationships

STRB (waveform L) will then be applied to U5 pin 12. This changes the state of flip-flop U5. Since the **RETRACE** signal to U4 pin 9 is not low, U5 pin 11 output will be routed via U23A, U4C and U23B to U20A analog switch. U20A analog switch closes and the ramp starts toward −10V. The **L DWELL EN** line also goes low to enable the dwell from U27 comparator pin 7.

At the next dwell (T2 and T3), the events of T0 and T1 will repeat.

6K-11 ±10V REFERENCE SUPPLIES, DETAILED CIRCUIT DESCRIPTION

There are four reference supplies on the A17 Analog Instruction PCB:

- +10V REF T
- −10V REF T
- +10V REF 2
- −10V REF 2

The ±10V REF T supplies are used for reference for the ramp generator and frequency instruction circuits. They also supply +10V REF T to the A18-A21 YIG Driver PCBs and a +10V REF to the A29 Rear Panel Interface. The ±10V REF 2 references supply reference voltages for the DVM and power meter circuits.

U30 is a precision 10V regulator used as reference for U31. U31A buffers and filters the precision regulator output for +10V REF "T" supply. U31B inverts the +10V and filters it for the −10V REF.

U28 and U29 circuits operate in an identical manner to the U30 and U31 circuits.

6K-12 FREQUENCY INSTRUCTION, DETAILED CIRCUIT DESCRIPTIONS

The Frequency Instruction circuits consists of the following subparts:

- Tune DAC
- Sweep Width DAC
- Analog Sweep Correction
- Linearizer DAC

6K-12.1 Tune DAC

Shown on sheet 3 of the schematic set is U34, a 16-bit multiplying DAC with 65,536 points of resolution. Dividing 10V by 65,536 results in 152.6 µV per point. The DAC input is first loaded by U8, then U2. Pins 19 and 20 are then strobed; this loads the internal latches of the DAC. The reference input is pin 13 and is supplied with either the +10V REF T or −10V REF T supply through analog switches U33A and U33B. U35 converts the DAC output current to a voltage that is inverted from the input reference voltage on U34 pin 13. Analog switch U33D in the feedback path of U35 compensates for the voltage drop and temperature drift of U33A and U33B.

In CW mode of operation, U33A will be closed; this results in a 0 to +10V output at U35 pin 6. This voltage is applied through U41B to R51 and U37. This is a unity gain inverting path, so U37 pin 6 output can go from 0V to −10V. U41B and U33C provide temperature drift compensation.

In broadband sweep modes, it is necessary that the U34 offset a very high ΔF ramp voltage. At this time, U41A closes and puts R52 in parallel with R51. This results in a gain of 4 for U37.

6K-12.2 Sweep Width DAC

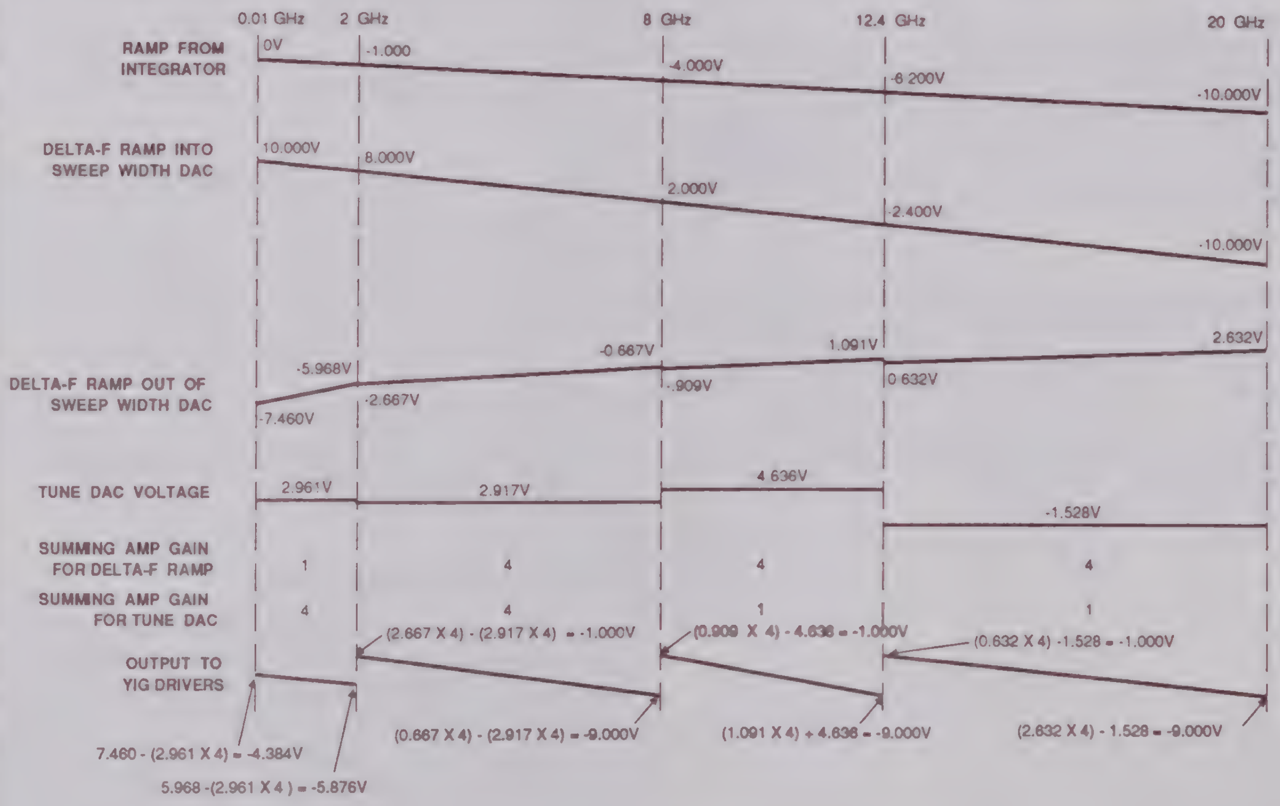
Also shown on sheet 3 of the schematic set are U38 and U39 which comprise the sweep width control circuit. The DAC and amplifier are identical to the tune DAC. The reference input is a −10V to +10V ΔF ramp. U39 inverts this ramp and applies it to U36 analog switch. U36A provides a gain of 1 while U36A together with U36B provide a gain of 4. This ΔF ramp is then summed with the tune DAC output. See Figure 6K-5 for a description of the gain settings for various sweep widths.

The ΔF ramp is also applied to P1 pin 63 which goes to the A16 FM PCB. When the sweep width is ≤50 MHz, the ramp is applied to the FM coil of the YIG oscillator instead of to the main coil. Under this condition, both U36A and U36B are open and an analog switch on the A16 PCB is closed. The tune DAC then sets the voltage for the center frequency of the sweep.

6K-12.3 Analog Sweep Correction

In analog sweep, the frequencies on both sides of each band switch point and at the top and bottom of the sweep are phase locked. The phase lock error voltage is read and, on the next sweep, the tune DAC and sweep width DAC are adjusted by the A23 Microprocessor PCB for improved accuracy. During sweeps <50 MHz, the center frequency of the sweep is phase locked and corrected. This is accomplished at the top of the sweep by opening the analog switch on the A16 FM PCB to remove the ΔF ramp from the FM coil.

At a point where the 67XXA phase locks during a sweep, as indicated previously, the A23 Microprocessor sets the appropriate DACs to get the frequency requested. The frequency is phase locked and the error voltage, wich is approximately 1 volt/MHz, is measured. During retrace of the sweep, the A23 Microprocessor calculates the new DAC setting to correct these errors. The next sweep, the errors are corrected and accuracy checked. The accuracy is continuously checked each sweep so than any temperature drift or drift with time will automatically be corrected.


0.01 GHz
2 GHz
8 GHz
12.4 GHz
20 GHz
RAMP FROM INTEGRATOR
0V
-1.000
-4.000V
-6.200V
-10.000V
DELTA-F RAMP INTO SWEEP WIDTH DAC
10.000V
8.000V
2.000V
-2.400V
-10.000V
DELTA-F RAMP OUT OF SWEEP WIDTH DAC
-5.968V
-0.667V
1.091V
2.632V
-7.460V
-2.667V
-.909V
0.632V
TUNE DAC VOLTAGE
2.961V
2.917V
4.636V
-1.528V
SUMMING AMP GAIN FOR DELTA-F RAMP
1
4
4
4
SUMMING AMP GAIN FOR TUNE DAC
4
4
1
1
OUTPUT TO YIG DRIVERS
(2.667 X 4) - (2.917 X 4) = -1.000V
(0.909 X 4) - 4.636 = -1.000V
(0.632 X 4) -1.528 = -1.000V
(0.667 X 4) - (2.917 X 4) = -9.000V
(1.091 X 4) + 4.636 = -9.000V
(2.632 X 4) - 1.528 = -9.000V
7.460 - (2.961 X 4) = -4.384V
5.968 -(2.961 X 4) = -5.876V
6700A036

NOTES:
1. The tuning voltages, -1V & -9V, are typical tuning voltages for the yigs and will vary from one yig to another.
2. The voltages given are rounded off to the nearest millivolt.
3. The above figure is for a typical 6747A. Other models will vary as far as switchpoint voltages and dac settings.
4. These voltages and gain settings will also depend on the sweep width and center frequency settings.

Figure 6K-5. YIG Oscillator Tuning Voltages

6K-12.4 Linearizer DAC

YIG oscillators have a linear frequency output with a linear tuning current input. However, they do have some nonlinearities on the order of 0.05%; these are typically at the top third of the band. Any nonlinearity can cause significant errors in analog sweep between the two phase locked end points (see Figure 6K-6). U42, U32, and Q1 on sheet 3 of the schematic set form a programmable linearizer to reduce the frequency errors caused by nonlinearity of the YIG oscillator.

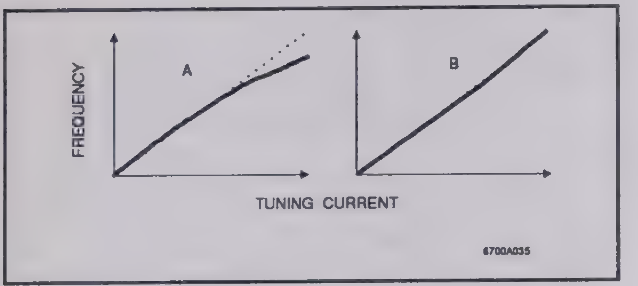


Figure 6K-6. Frequency Versus Tuning Voltage

Figure 6K-7 illustrates some of the possible settings of the linearizer DAC. U42 is a dual 8-bit DAC. Side B uses −10V REF T as a reference and is used to set the breakpoint of the linearizer. The output of U32C is summed with the tune output voltage from U37 pin 6 at the base of Q1. If the breakpoint DAC is set to +5V and the output of the tune is 0V, the base of Q1 will be at +0.6V, thereby setting the input to U42 pin 4 to 0V. As the output of U37 pin 6 goes higher than −5V, the input to U42 pin 4 will then start following the sweep. The output of U32 pin 7 is inverted from U42 pin 4 input and applied through R68 to U32 pin 13.

If linearizer DAC U42A is set to half of full scale (7F hex; 0111-1111 binary), then the output of U32B will be half of the input at U42 pin 4 and of opposite polarity. The output of Q1 is also tied to R61 which is twice the value of R68. Since the currents through R61 and R68 are equal and opposite, the output of U32D will be 0V. If U42A is set to some other value, then these currents will not be equal and opposite and their difference will be amplified by U32D. The polarity will be determined by the direction of the setting of U42A away from the halfway point of full scale. The magnitude of the output will be determined by both the setting of U42A and U42B with the maximum output being with U42B set to 0V and U42A being at no output or at full scale output.

The output of U32D will be summed through R56 with the tune DAC and sweep width DAC voltages. This then adds to or subtracts from the normal output voltage of U37 pin 6 to provide the correction for YIG linearity.

Calibration of the linearity is done automatically during the frequency calibration of each YIG oscillator by the A23 Microprocessor. In multiband 67XXA models, the values loaded into the linearization DACs will change at each bandswitch point. This automatically corrects for the YIG linearity in both CW and sweep modes of operation.

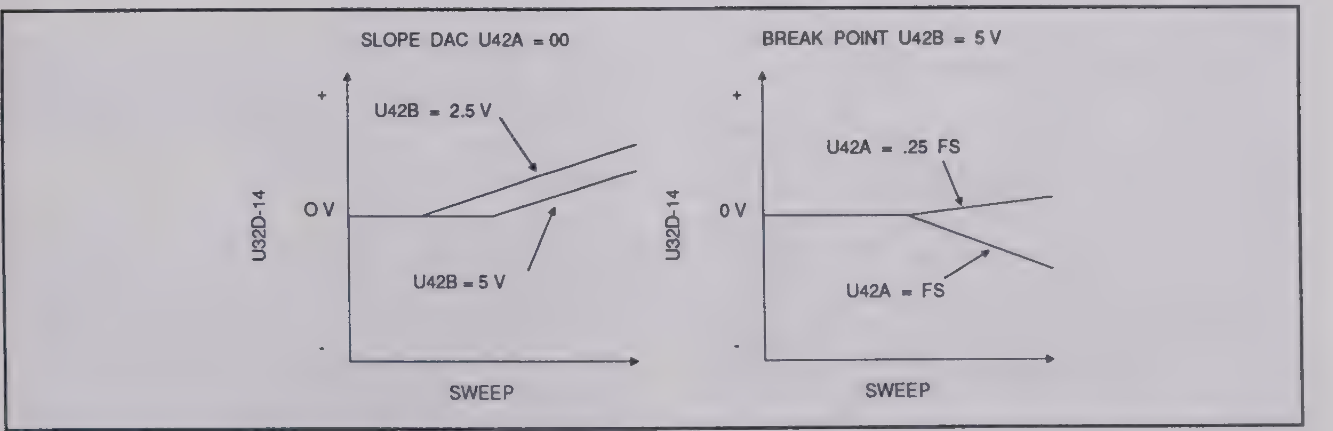


Figure 6K-7. Linearizer DAC Settings

6K-13 DIGITAL VOLTMETER, DETAILED CIRCUIT DESCRIPTION

U3, on sheet 1 of the schematic set, is an analog-to-digital converter (ADC) connected directly to the A23 Microprocessor bus. It has its own built-in DAC that is compared with the input analog signal at pin 14. Using a successive approximation algorithum in its own built-in microprocessor, it adjusts the DAC until its output equals the analog input. It then creates the digital word to set the value of the A17 PCB DAC that is available to the A23 Microprocessor.

The analog input to U3 pin 14 is comes from the Sample/Hold integrated circuit, U10 pin 5. The signal applied to U10 pin 3 charges C8 when an analog-to-digital conversion is not taking place. During the convert mode (analog-to-digital conversion) of U3, the STS line, pin 28, goes low. STS is inverted by U4B and applied to U10 pin 8. This puts U10 in the "HOLD" mode so that the input to U3 will be stable during its conversion, even though the input to U10 may be changing.

Figure 6K-8 shows the control signal timing for operation of the DVM in both the 8-bit and 12-bit conversion modes.

At the start of the conversion, A0 (U3 pin 4) determines if an 8-bit or 12-bit conversion is to be made. R/C (U3 pin 5) determines if U3 is to do a conversion or to make the conversion data available to the A23 Microprocessor (read). The CE input (U3 pin 6) is brought high for approximately 800 ns. The STS line from U3 pin 28 goes low approximately 200 ns after the CE goes high to tell the sample/hold U10 to go into hold. About 15 µs later, the A0 and R/C lines change state in preparation for a read cycle. An 8-bit conversion takes a maximum of 24 µs and a 12-bit conversion takes a maximum of 35 µs. The processor waits after the initiate conversion 27 µs and 36 µs, respectively, and then initiates a read.

For an 8-bit conversion, the read is initiated by bringing the CE line high for approximately 800 µs. Shortly there after, U3 puts the data on the processor bus where it is read by the A23 Microprocessor. For a 12-bit conversion, the read cycle must be initiated twice. During the first read cycle, the processor reads the LSB which contains the 4 least significant bits and 4 zeros. During the second read cycle, the processor reads the MSB which is the full 8 bits.

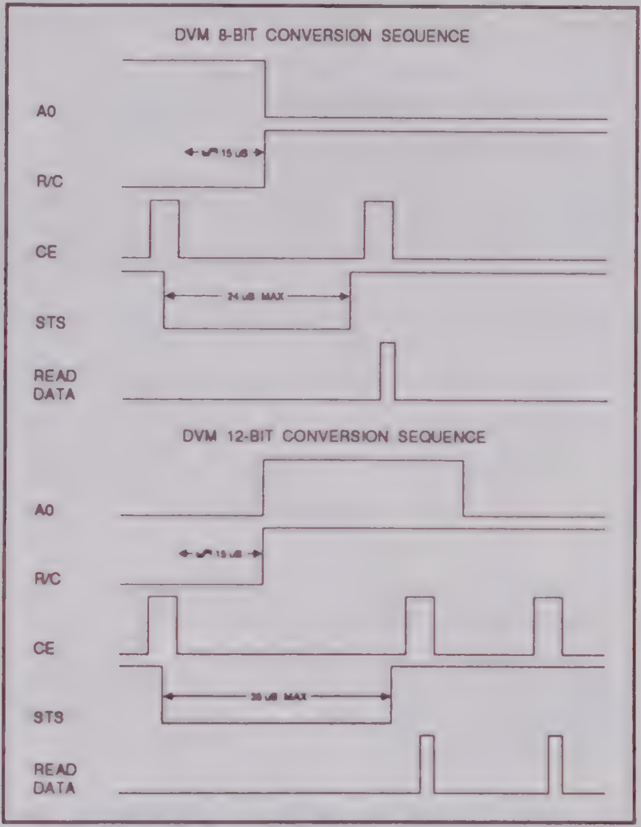


Figure 6K-8. DVM Control Signal Timing

A0 and R/C are set by the A23 Microprocessor via U1. CE is set by either U14 pin 13 or 14 which are also controlled by the processor. +10V REF 2 is applied to U3 pin 10, rather than using the internal reference of the A-D converter itself, to improve accuracy. It is also applied to B/P OFF (bipolar offset) to allow the DVM to have a full-scale operating range of +10V to –10V. For a 12-bit conversion, this allows 11-bit resolution for 0V to +10V and 11-bit resolution for 0V to –10V or 5 mV resolution for +10V to –10V.

U15 provides an additional two ranges for the DVM. When U15A switch is closed, the range of the DVM is +20V to –20V for all inputs except U13 pin 4 which is +100V to –100V. U15B provides for a +20 to –10V range for the U12 pin 4 input.

U13 pin 4 input is tied to TP2 through R15. This provides an internal DVM for general test and troubleshooting purposes. It has a range of +100V to –100V and is auto-ranging for maximum resolution. This DVM is accessed from the front panel by pressing SHIFT, TRIGGER, 083. The voltage is then indicated on the **LEVEL** display on the front panel.

Table 6K-4. DVM Multiplexer Truth Table

	EN	A0	A1	A2
NONE	0	X	X	X
S1	1	0	0	0
S2	1	1	0	0
S3	1	0	1	0
S4	1	1	1	0
S5	1	0	0	1
S6	1	1	0	1
S7	1	0	1	1
S8	1	1	1	1

The various inputs to the DVM are applied through analog multiplexers (MUXs) U7, U9, and U13. These are 8-to-1 multiplexers and are controled by the A23 Microprocessor via U1.

Table 6K-4 shows the truth table for logic inputs versus analog input for each selected output.

6K-14 POWER METER, DETAILED CIRCUIT DESCRIPTION

The power meter circuit, shown on sheet 4 of the schematic set, is a programmable gain amplifier and digital logrithmic amplifier. At low voltages, the amplifier has a gain of up to 10,000. The curve fitting of the detector output to a logrithmic (dB) scale is performed by the A23 Microprocessor from a stored data table. The power meter circuit also has provision for correcting the temperature and the frequency calibration factors of the detector automatically. The indicator for the power meter is the front panel LEVEL display and is enabled when the EXT PWR MTR key is pressed. If there is no detector physically connected to the rear panel or if there is no RF power applied to the detector, the display will indicate LLL.

6K-14.1 Input Chopper Amplifier

The dc voltage from the detector is applied to A17 pin 47 through R65 to quad-analog switch U46. When **L SAMPLE 1** is true, U46A and U46C are closed connecting the detector to U47 pin 5. U47 and U48A are arranged as an instrumentation amplifier. U48 pin 7 will follow the input to U47B. When **L SAMPLE 2** is true, the connector is then connected to U47 pin 3. U48A will then invert this signal and its output will be equal but opposite of when **L SAMPLE 1** is true. This chopping is done at a 10 Hz rate, controlled by the A23 Microprocessor during housekeeping.

Table 6K-5. Programmable Gain Amplifier (Gain Versus Detector Input Voltage)

POWER LEVEL	+10 dBm	0 dBm	-10 dBm	-20 dBm	-30 dBm	-40 dBm
DETECTOR OUTPUT	-441 mV	-172 mV	-34.2 mV	-4.39 mV	-459 uV	-50 uV
L 1X A	0	0	1	1	1	1
L 10X A	1	1	0	0	1	1
L 100 A	1	1	1	1	0	0
L 1X B	1	1	1	1	1	1
L 10X B	0	0	0	1	1	1
L 100X B	1	1	1	0	0	0
TOTAL GAIN	10	10	100	1,000	10,000	10,000
V DET (TP 10)	4.41 V	1.72 V	3.42 V	4.39 V	4.59 V	0.5 V

6K-14.2 Programmable Gain Amplifier

U48B and U51A are the same and each has a gain of from 1 to 100. The 10 Hz square wave from U48 pin 7 is applied to U48B and amplified. It is then ac coupled to U51A where it is again amplified and applied to U50A and U52B analog switches. Table 6K-5 shows the gain versus detector input voltage.

6K-14.3 Synchronous Detector

The synchronous detector converts the amplified 10 Hz square wave back to a dc voltage appropriate for the A17 PCB's DVM circuit. When **L SAMPLE 1** is true, the amplified detector voltage into U50A and U50B analog switches is negative; U50A switch will be closed. The negative detector signal will be routed through U51B to the inverting input of U52B. When **L SAMPLE 2** is true, the amplified detector voltage into U50A and U50B will be positive. U50B switch will be closed. The positive detector signal will then be routed through U52A to the non-inverting input of U52B. In both cases, the output of U42B will be positive.

6K-14.4 Temperature Compensation and Offset Amplifiers

U45B and U45C are connected in a bridge configuration. The detector thermistor is 1 MOhm at 25°C. At this time, the voltage at pins 5 and 6 of U45 will be –5V and the bridge will be balanced. As the temperature of the thermistor decreases, the voltage at the junction of R98 and R94 will go toward 0V. This will cause the output of U45B to go negative. As the temperature decreases, the output of U45B will go positive. This voltage change is read by the A17 PCB's DVM and the A23 Microprocessor and is used to correct the power reading on the front panel LEVEL display as the temperature of the detector changes.

The detector also has a 1 MOhm nominal resistance connected to the input of U45C. The actual value of the resistor is determined during calibration of the detector head itself. The voltage change caused by this calibration resistor is also read by the A17 PCB's DVM and A23 Microprocessor. It is used so that for a given power, the front panel LEVEL display will be the same for any compatible detector head.

6K-15 ANALOG INSTRUCTION PCB, TROUBLESHOOTING

Troubleshooting procedures in Table 6K-6 cover the A17 Analog Instruction PCB.

6K-16 ANALOG INSTRUCTION PCB, SERVICE SHEETS

Table 6K-1 on the first page of this section presents the arrangements of the block diagrams, schematics, and parts locater diagrams for the A17 PCB.

Table 6K-6. Analog Instruction Troubleshooting (1 of 2)

Trouble / Error Code	Troubleshooting Procedure
	A17 Analog Instruction PCB Troubleshooting Routines
<Shift> TRIGGER 191 Tune DAC Test	Sweeps Tune DAC from 0 to 100% and dwells at top and bottom with: • Tune DAC Output set to "–" • Fast Retrace • Gain set to 1
<Shift> TRIGGER 192 Sweep Width DAC Test	Sweeps Sweep Width DAC from 0 to 100% and dwells at top and bottom with: • Integrator off • Fast Retrace • Gain set to 1
<Shift> TRIGGER 193 Tune and Sweep Width Linearity Test	191 and 192 performed at same time.
<Shift> TRIGGER 194 Linearizer Slope DAC Test	Sweeps Linearizer Slope DAC from 0 to 100% with: • Breakpoint DAC set to 0 • Tune DAC set to 71.667% • Gain 1 open • Sweep Width Gain 1 and 4 open
<Shift> TRIGGER 195 Linearizer Breakpoint DAC Test	Sweep Linearizer Breakpoint DAC from 0 to 100% with: • Slope DAC set to 100% • Tune DAC set to 71.667% • Gain 1 open • Sweep Width Gain 1 and 4 open
<Shift> TRIGGER 196 Sweep Time DAC Test	Sweep the Sweep Time DAC from 0 to 100% with: • Ramp Integrator off • Clear Dwell • Disable Dwell • No Retrace • Sweep Time Range set to less than 1 second • Ignore Dwell Interrupt
<Shift> TRIGGER 197 Marker-Switch Point DAC	Sweep Marker-Switch Point DAC with • Disable Dwell • Clear Dwell • Ignore Dwell Interupt • Sweep Time Range set to 1 second • Sweep Time DAC to 100% • Integrator off
<Shift> TRIGGER 198 Ramp Generator Open-Loop Test	Operate Switch-Point DAC with open loop test to test control logic of: • L Dwell Enable • Clear Dwell • Retrace

Table 6K-6. Analog Instruction Troubleshooting (2 of 2)

Trouble / Error Code	Troubleshooting Procedure
	A17 Analog Instruction PCB Troubleshooting Routines (Continued)
<Shift> TRIGGER 150 DVM Linearity test	Sweeps the Tune DAC in 5 mV steps (Gain 1). The A23 Microprocessor reads the DVM, then outputs the value to the Sweep Width DAC with: • Integrator off • Gain 1 & 4 open
<Shift> TRIGGER 151 Use DVM as external DVM (TP2)	Displays the DVM voltage in the front panel LEVEL display.
<Shift> TRIGGER 152 MUX Test	Displays the DVM voltage in the front panel LEVEL display. Use front panel DECREASE/INCREASE keys to increment through MUX ports. Displays the active MUX port on the front panel MODULATION display.

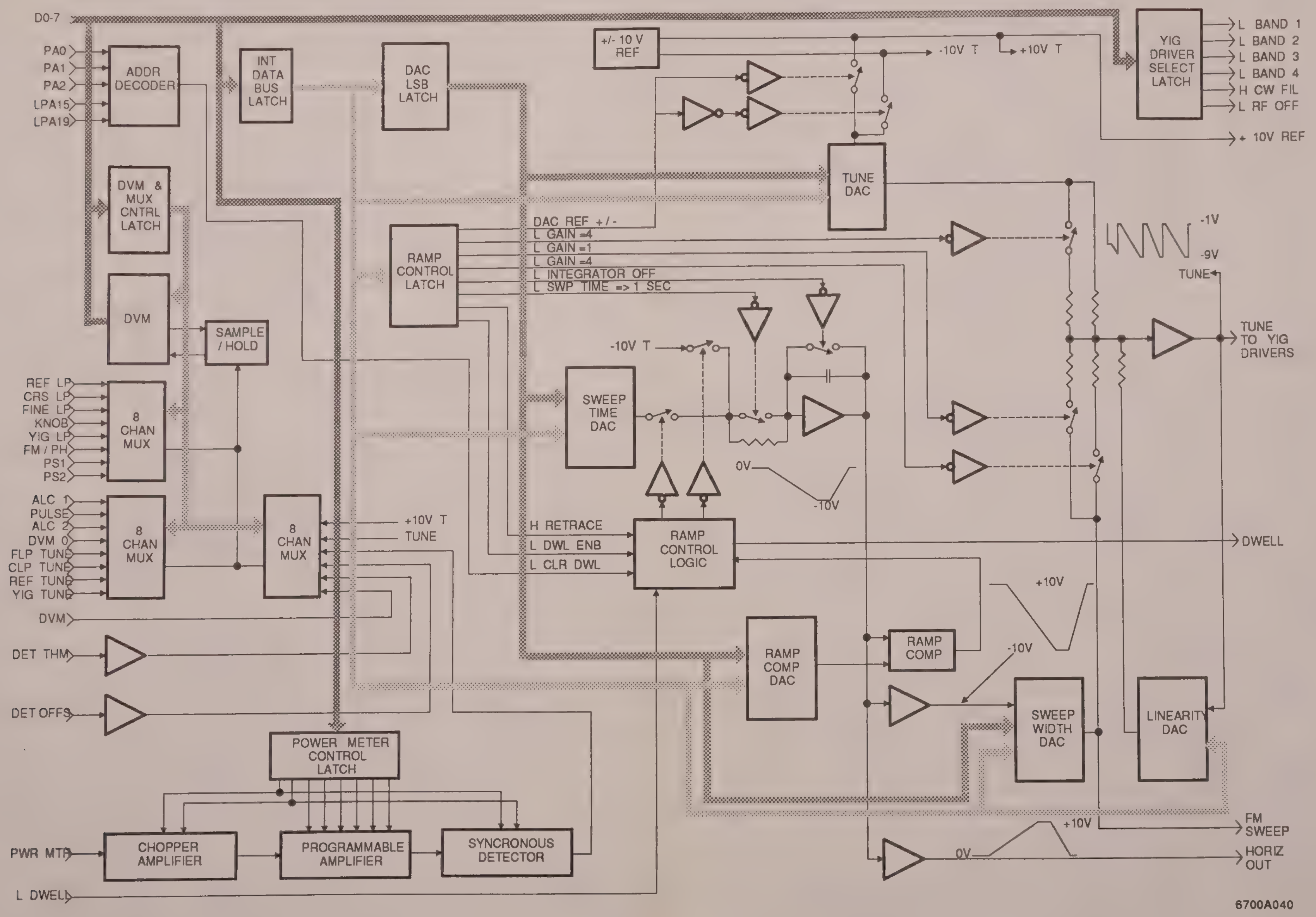
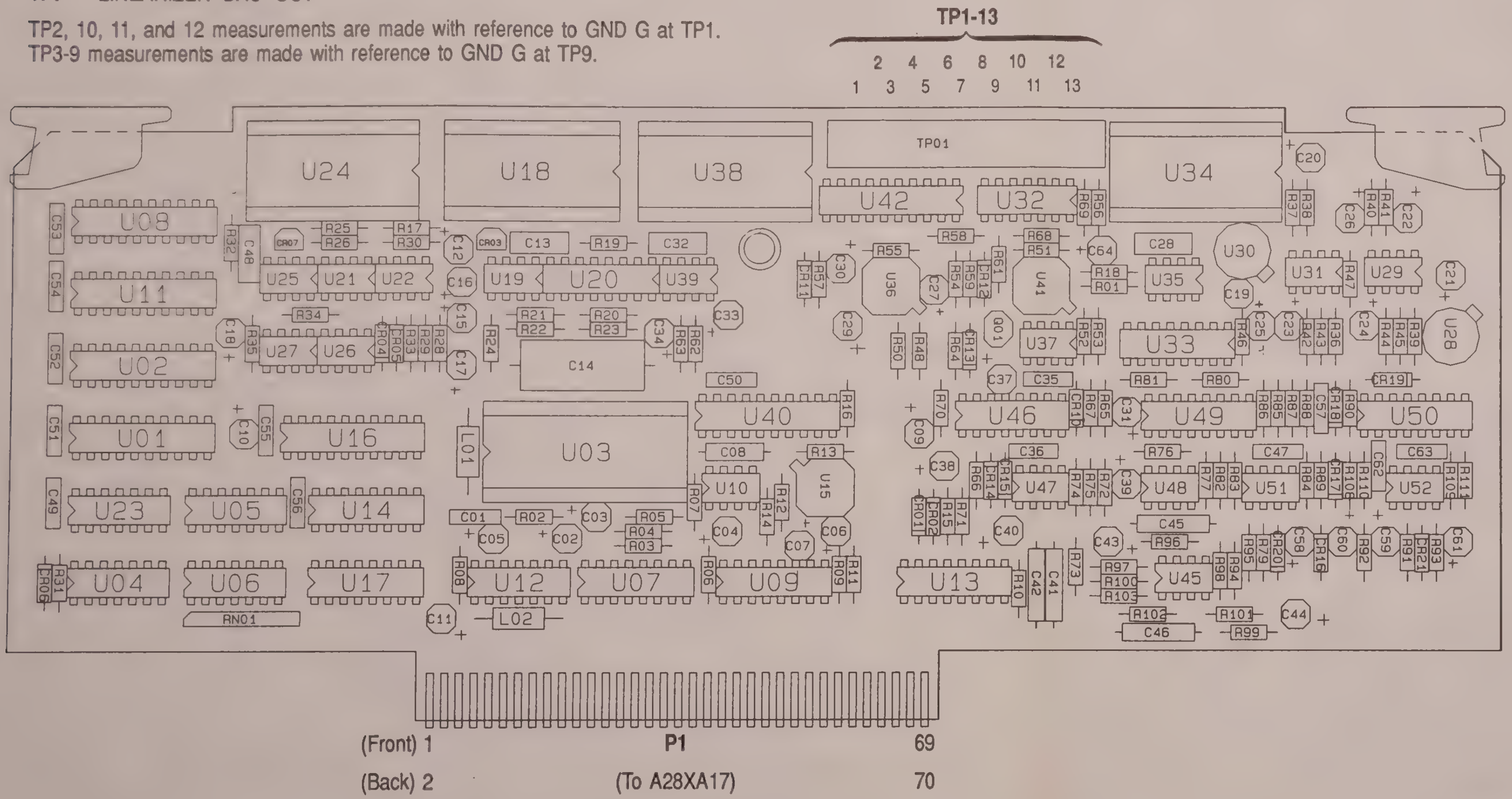

D0-7
PA0
PA1
PA2
LPA15
LPA19
ADDR DECODER
INT DATA BUS LATCH
DAC LSB LATCH
+/- 10 V REF
-10V T
+10V T
YIG DRIVER SELECT LATCH
L BAND 1
L BAND 2
L BAND 3
L BAND 4
H CW FIL
L RF OFF
+ 10V REF
DVM & MUX CNTRL LATCH
TUNE DAC
DAC REF +/-
L GAIN =4
L GAIN =1
L GAIN =4
L INTEGRATOR OFF
L SWP TIME => 1 SEC
RAMP CONTROL LATCH
-1V
-9V
TUNE
DVM
SAMPLE / HOLD
TUNE TO YIG DRIVERS
-10V T
REF LP
CRS LP
FINE LP
KNOB
YIG LP
FM / PH
PS1
PS2
8 CHAN MUX
SWEEP TIME DAC
0V
-10V
ALC 1
PULSE
ALC 2
DVM 0
FLP TUNE
CLP TUNE
REF TUNE
YIG TUNE
8 CHAN MUX
8 CHAN MUX
+10V T
TUNE
H RETRACE
L DWL ENB
L CLR DWL
RAMP CONTROL LOGIC
DWELL
+10V
DVM
DET THM
DET OFFS
RAMP COMP DAC
RAMP COMP
-10V
SWEEP WIDTH DAC
LINEARITY DAC
POWER METER CONTROL LATCH
PWR MTR
CHOPPER AMPLIFIER
PROGRAMMABLE AMPLIFIER
SYNCRONOUS DETECTOR
+10V
FM SWEEP
0V
HORIZ OUT
L DWELL
6700A040

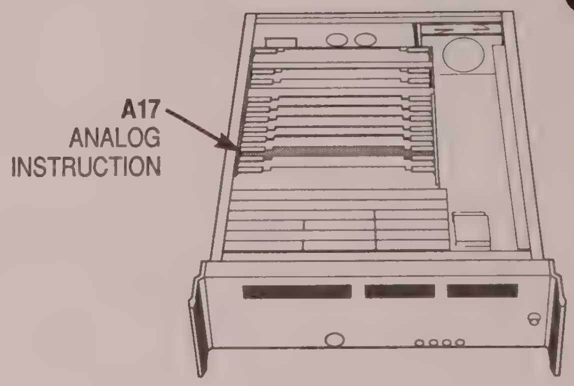
Figure 6K-9. A17 Analog Instruction PCB Block Diagram

TEST POINTS

TP1	GND G	**TP8**	FM SWP
TP2	DVM EXT INPUT	**TP9**	GND G
TP3	20V ΔF	**TP10**	V DET
TP4	TUNE DAC OUT	**TP11**	V TH
TP5	TUNE	**TP12**	V dBm
TP6	SWITCH POINT DET OUT	**TP13**	Not Used
TP7	LINEARIZER DAC OUT		

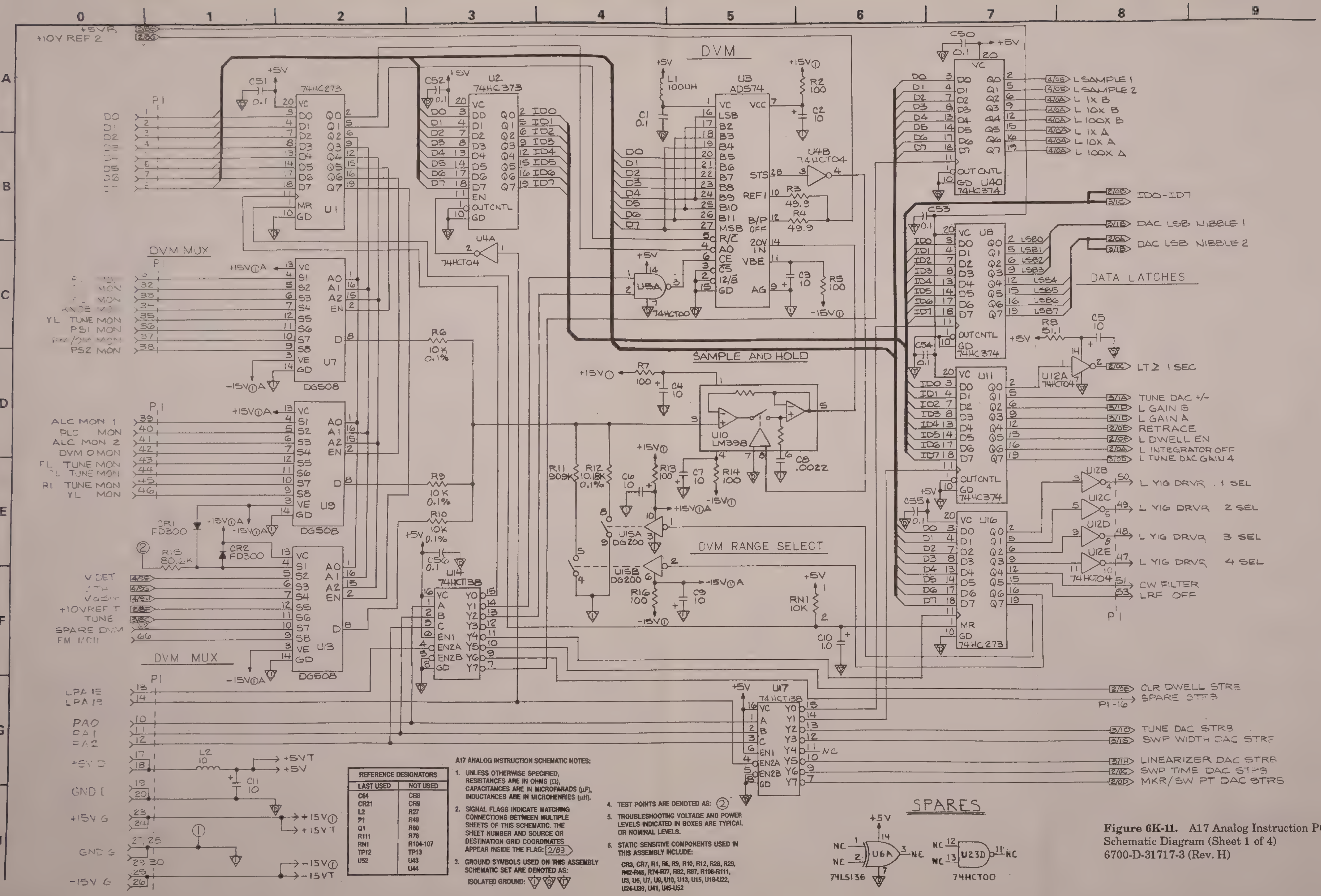
TP2, 10, 11, and 12 measurements are made with reference to GND G at TP1.
TP3-9 measurements are made with reference to GND G at TP9.


TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
TP01
U24
U18
U38
U34
U42
U32
U08
U11
U02
U01
U23
U04
U25
U21
U22
U19
U20
U39
U27
U26
U16
U05
U14
U06
U17
RN01
U03
U40
U10
U15
U12
U07
U09
U36
U41
U35
U30
U31
U29
U28
U37
U33
U46
U49
U50
U47
U48
U51
U52
U13
U45
C14
C13
C32
C28
C50
C08
C01
C45
C46
C36
C47
C63
L01
L02
Q01
R25
R26
R17
R30
R19
R34
R21
R22
R20
R23
R55
R58
R68
R51
R18
R01
R81
R80
R76
R13
R02
R05
R04
R03
R96
R97
R100
R103
R102
R101
R99
CR19
(Front) 1
P1
69
(Back) 2
(To A28XA17)
70


A17
ANALOG
INSTRUCTION

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6K-10. A17 Analog Instruction PCB Parts Locater Diagram
6700-D-31717-3 (Rev. G)



0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
+5VR
+10V REF 2
DVM
DVM MUX
SAMPLE AND HOLD
DVM RANGE SELECT
DATA LATCHES
SPARES
P1
74HC273
U1
74HC373
U2
AD574
U3
74HCT04
U4A
U4B
L1 100UH
R2 100
C2 10
C1 0.1
R3 49.9
R4 49.9
C3 10
R5 100
U3A
74HCT00
DG508
U7
U9
U13
R6 10K 0.1%
R9 10K 0.1%
R10 10K 0.1%
74HCT138
U14
U17
LM398
U10
R7 100
C4 10
R11 909K
R12 10.18K 0.1%
R13 100
R14 100
C6 10
C7 10
C8 .0022
U15A DG200
U15B DG200
R16 100
C9 10
RN1 10K
C10 1.0
CR1 FD300
CR2 FD300
R15 80.6K
L2 10
C11 10
C50 0.1
C51 0.1
C52 0.1
C53 0.1
C54 0.1
C55 0.1
C56 0.1
U40 74HC374
U8 74HC374
U11 74HC374
U16 74HC273
U12A
U12B
U12C
U12D
U12E
R8 51.1
C5 10
DO
D1
D2
D3
D4
D5
D6
D7
ID0–ID7
ALC MON 1
PLC MON
ALC MON 2
DVM 0 MON
FL TUNE MON
RL TUNE MON
YL MON
YL TUNE MON
PS1 MON
PS2 MON
V DET
+10VREF T
TUNE
SPARE DVM
FM MON
LPA15
LPA19
PA0
PA1
PA2
+5V D
GND I
+15V G
GND G
-15V G
+5VT
+5V
+15V①
+15VT
-15V①
-15VT
+15V①A
-15V①A
L SAMPLE 1
L SAMPLE 2
L 1X B
L 10X B
L 100X B
L 1X A
L 10X A
L 100X A
IDO-ID7
DAC LSB NIBBLE 1
DAC LSB NIBBLE 2
LT ≥ 1 SEC
TUNE DAC +/-
L GAIN B
L GAIN A
RETRACE
L DWELL EN
L INTEGRATOR OFF
L TUNE DAC GAIN 4
L YIG DRVR 1 SEL
L YIG DRVR 2 SEL
L YIG DRVR 3 SEL
L YIG DRVR 4 SEL
CW FILTER
LRF OFF
CLR DWELL STRB
SPARE STRB
P1-16
TUNE DAC STRB
SWP WIDTH DAC STRB
LINEARIZER DAC STRB
SWP TIME DAC STRB
MKR/SW PT DAC STRB
NC
U6A
74LS136
U23D
74HCT00

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C64	CR8
CR21	CR9
L2	R27
P1	R49
Q1	R60
R111	R78
RN1	R104-107
TP12	TP13
U52	U43
	U44

A17 ANALOG INSTRUCTION SCHEMATIC NOTES:

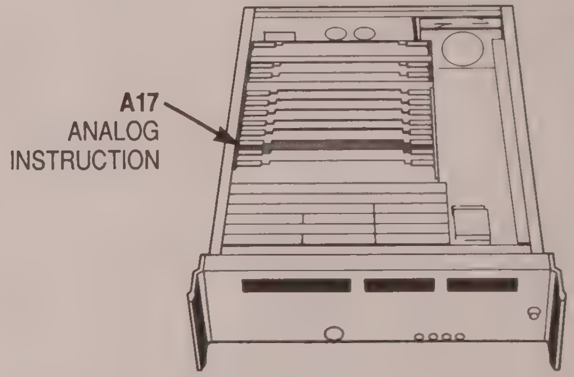
1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   ISOLATED GROUND: I D T
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR3, CR7, R1, R6, R9, R10, R12, R28, R29, R42-R45, R74-R77, R82, R87, R108-R111, U3, U6, U7, U9, U10, U13, U15, U18-U22, U24-U39, U41, U45-U52

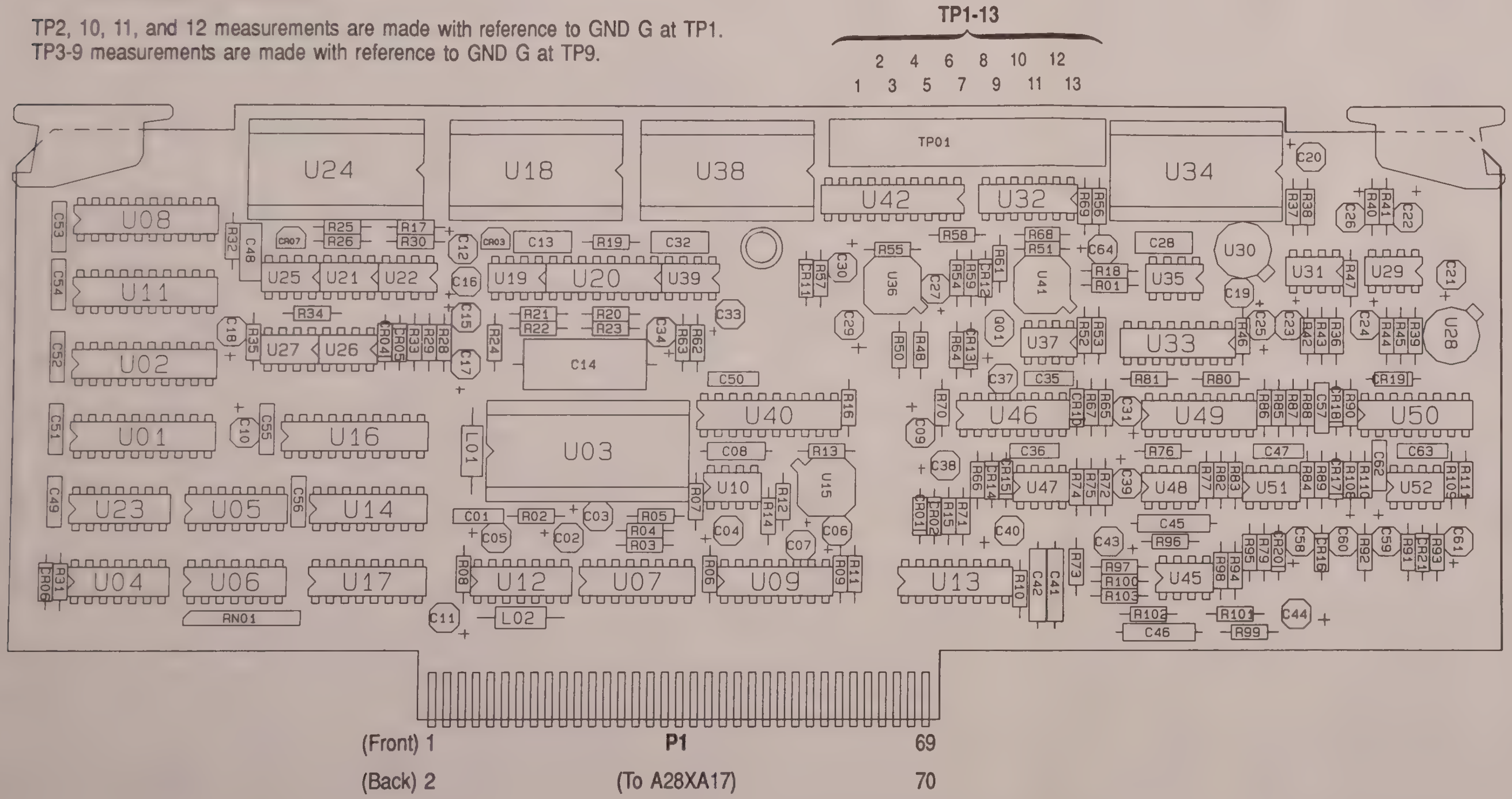
Figure 6K-11. A17 Analog Instruction PCB Schematic Diagram (Sheet 1 of 4)
6700-D-31717-3 (Rev. H)

TEST POINTS

TP1	GND G	**TP8**	FM SWP
TP2	DVM EXT INPUT	**TP9**	GND G
TP3	20V ΔF	**TP10**	V DET
TP4	TUNE DAC OUT	**TP11**	V TH
TP5	TUNE	**TP12**	V dBm
TP6	SWITCH POINT DET OUT	**TP13**	Not Used
TP7	LINEARIZER DAC OUT		

TP2, 10, 11, and 12 measurements are made with reference to GND G at TP1.
TP3-9 measurements are made with reference to GND G at TP9.


A17
ANALOG
INSTRUCTION


TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
TP01
U24
U18
U38
U34
U42
U32
U08
U11
U02
U01
U23
U04
U25
U21
U22
U27
U26
U16
U05
U06
U14
U17
U19
U20
U39
U03
U10
U15
U12
U07
U09
U36
U41
U40
U37
U35
U30
U31
U29
U33
U28
U46
U47
U49
U48
U51
U50
U52
U45
U13
C14
C13
C32
C28
C50
C08
C01
C35
C36
C45
C46
C47
C63
L01
L02
RN01
C20
C26
C22
C21
C19
C64
C53
C54
C52
C51
C49
C48
C12
C16
C15
C17
C18
C10
C55
C56
C33
C34
C30
C29
C27
C37
C31
C39
C38
C09
C40
C43
C44
C41
C42
C11
C05
C02
C03
C04
C06
C07
C25
C23
C24
C57
C62
C58
C60
C59
C61
R25
R26
R17
R30
R19
R32
R34
R35
R21
R22
R20
R23
R24
R28
R29
R33
R63
R62
R58
R55
R57
R68
R51
R18
R01
R54
R59
R61
R56
R69
R37
R38
R40
R41
R47
R50
R48
R64
R52
R53
R46
R42
R43
R36
R44
R45
R39
R16
R13
R12
R14
R07
R02
R05
R04
R03
R08
R06
R09
R11
R31
R70
R65
R67
R81
R80
R76
R66
R75
R74
R72
R71
R73
R10
R97
R100
R103
R102
R101
R99
R96
R98
R94
R95
R79
R77
R82
R83
R84
R89
R86
R85
R87
R88
R90
R92
R91
R93
R108
R109
R110
R111
CR07
CR03
CR04
CR05
CR06
CR11
CR12
CR13
CR10
CR14
CR15
CR01
CR02
CR16
CR17
CR18
CR19
CR20
CR21
Q01
(Front) 1
P1
69
(Back) 2
(To A28XA17)
70

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6K-10. A17 Analog Instruction PCB Parts Locater Diagram
6700-D-31717-3 (Rev. G)

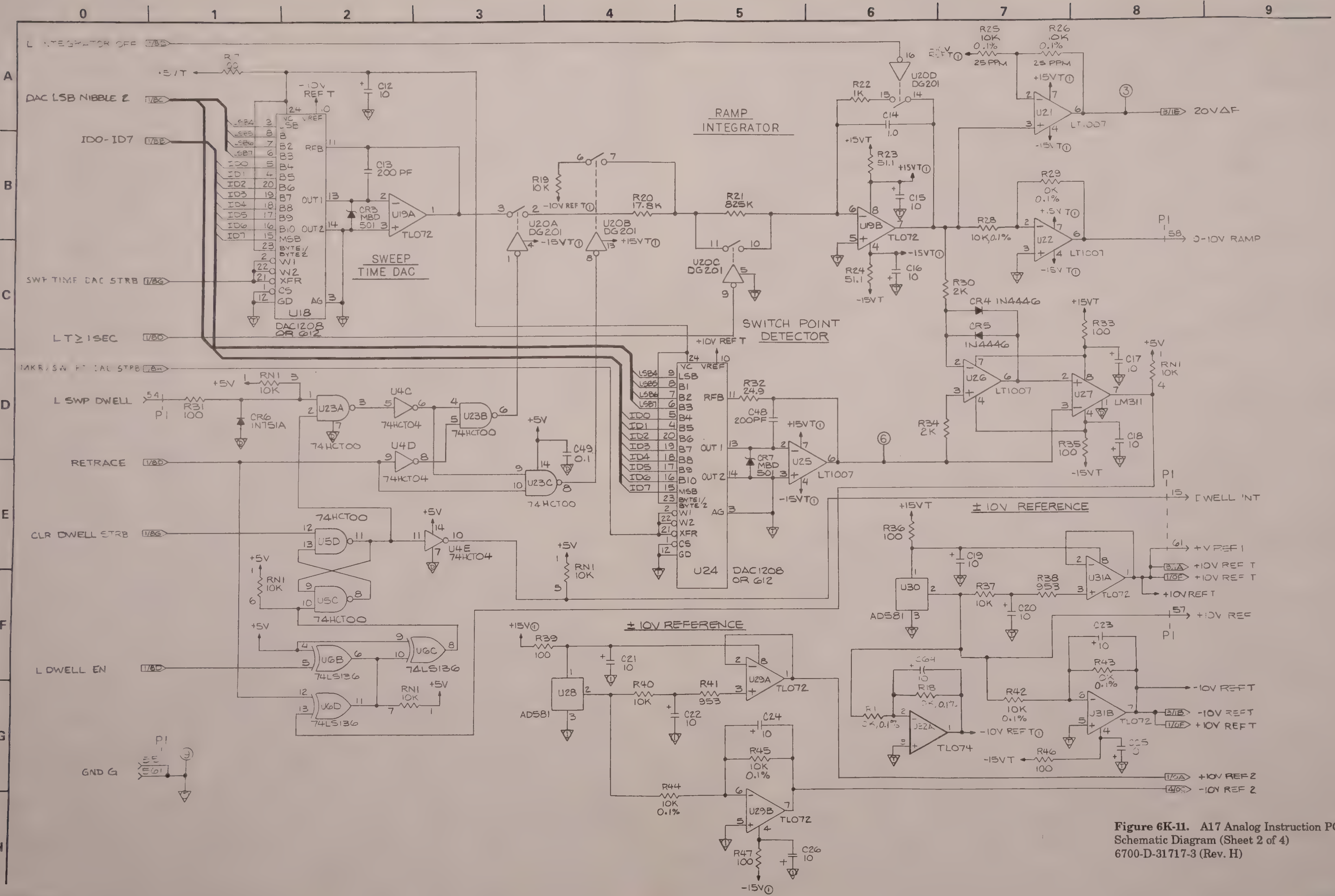
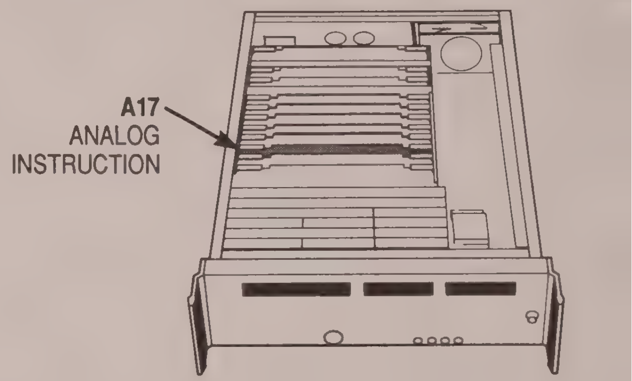

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
L INTEGRATOR OFF
+5/T
R7
DAC LSB NIBBLE 2
ID0-ID7
-10V REF T
C12
10
U18
DAC1208 OR 612
VC
VREF
LSB
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
MSB
BYTE1/BYTE2
W1
W2
XFER
CS
GD
AG
RFB
OUT1
OUT2
C13
200 PF
CR3
MBD 501
U19A
TL072
SWEEP TIME DAC
SWP TIME DAC STRB
LT≥1SEC
MKR/SW PT DAC STRB
L SWP DWELL
P1
R31
100
CR6
IN751A
RN1
10K
+5V
U23A
U4C
74HCT04
U23B
74HCT00
U4D
U23C
C49
0.1
RETRACE
CLR DWELL STRB
U5D
U5C
74HCT00
U4E
74HCT04
L DWELL EN
U6B
U6C
U6D
74LS136
GND G
R19
10K
-10V REF T
U20A
DG201
-15VT
U20B
DG201
+15VT
R20
17.8K
RAMP INTEGRATOR
R21
825K
U20C
DG201
SWITCH POINT DETECTOR
+10V REF T
U24
DAC1208 OR 612
R32
24.9
C48
200PF
CR7
MBD 501
U25
LT1007
U20D
DG201
R22
1K
C14
1.0
R23
51.1
C15
10
U19B
TL072
R24
51.1
C16
10
R25
10K
0.1%
25 PPM
R26
10K
0.1%
25 PPM
U21
LT1007
20VΔF
R29
10K
0.1%
R28
10K 0.1%
U22
LT1007
0-10V RAMP
R30
2K
CR4 IN4446
CR5
IN4446
R33
100
C17
10
RN1
10K
U26
LT1007
U27
LM311
R34
2K
R35
100
C18
10
DWELL INT
± 10V REFERENCE
R36
100
C19
10
U30
AD581
R37
10K
C20
10
R38
953
U31A
TL072
+V REF 1
+10V REF T
+10V REF
-10V REF T
R42
10K
0.1%
R43
10K
0.1%
C23
10
U31B
TL072
C25
10
R46
100
U32A
TL074
R1
10K, 0.1%
R18
10K, 0.1%
C64
10
+10V REF 2
-10V REF 2
± 10V REFERENCE
R39
100
U28
AD581
C21
10
R40
10K
C22
10
R41
953
U29A
TL072
C24
10
R45
10K
0.1%
R44
10K
0.1%
U29B
TL072
R47
100
C26
10
-15V

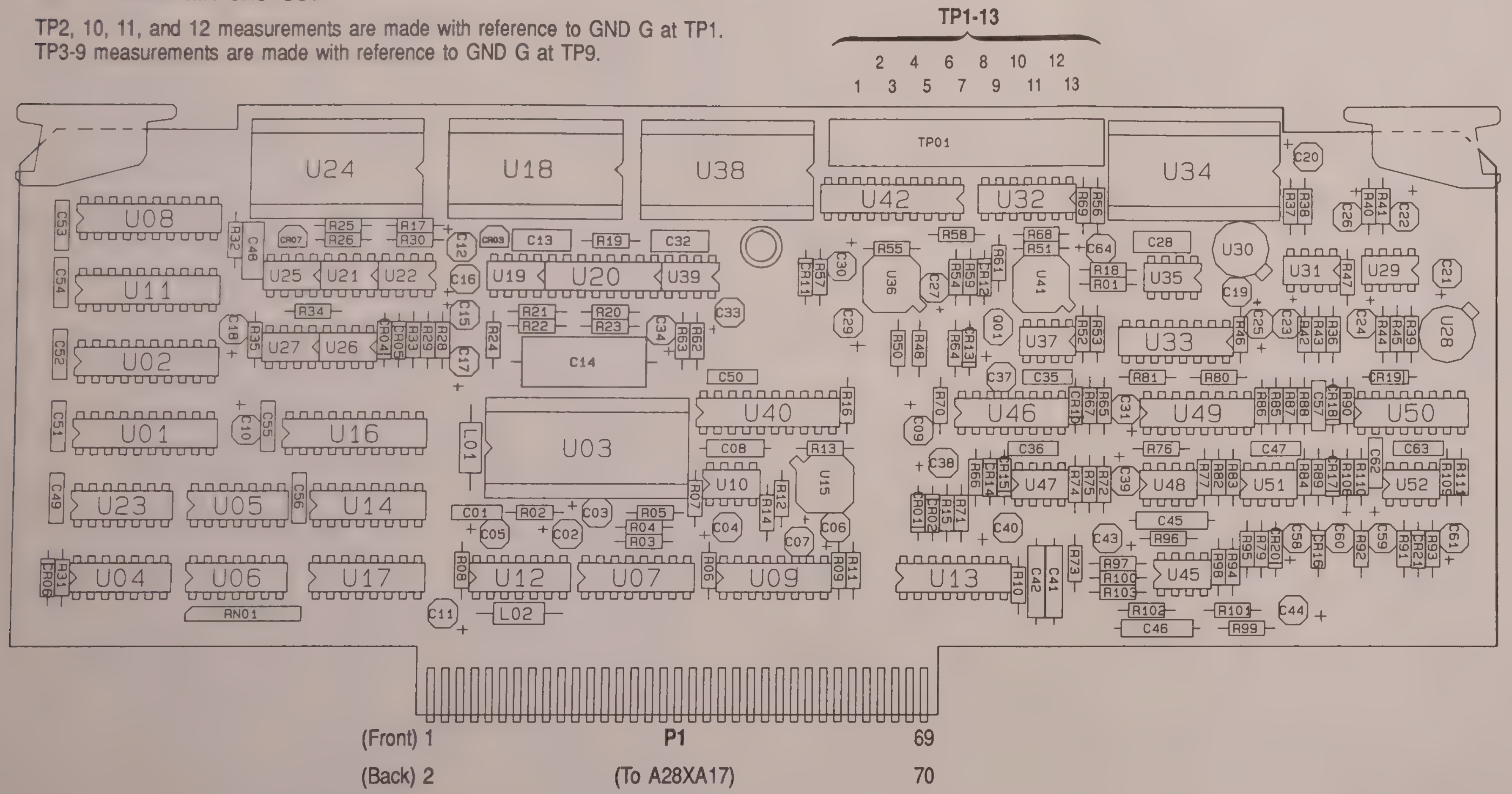
Figure 6K-11. A17 Analog Instruction PCB Schematic Diagram (Sheet 2 of 4)
6700-D-31717-3 (Rev. H)

TEST POINTS

TP1	GND G	**TP8**	FM SWP
TP2	DVM EXT INPUT	**TP9**	GND G
TP3	20V ΔF	**TP10**	V DET
TP4	TUNE DAC OUT	**TP11**	V TH
TP5	TUNE	**TP12**	V dBm
TP6	SWITCH POINT DET OUT	**TP13**	Not Used
TP7	LINEARIZER DAC OUT		

TP2, 10, 11, and 12 measurements are made with reference to GND G at TP1.
TP3-9 measurements are made with reference to GND G at TP9.


A17
ANALOG
INSTRUCTION


TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
TP01
U24
U18
U38
U34
U42
U32
U08
U11
U02
U01
U16
U23
U05
U14
U04
U06
U17
U25
U21
U22
U27
U26
U19
U20
U39
U03
U40
U10
U15
U12
U07
U09
U36
U41
U35
U30
U31
U29
U28
U37
U33
U46
U49
U50
U47
U48
U51
U52
U13
U45
C14
C13
C32
C50
C08
C01
C05
C02
C03
C04
C06
C07
C11
C28
C35
C36
C37
C45
C46
C47
C63
C41
C42
L01
L02
RN01
(Front) 1
P1
69
(Back) 2
(To A28XA17)
70

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6K-10. A17 Analog Instruction PCB Parts Locater Diagram
6700-D-31717-3 (Rev. G)

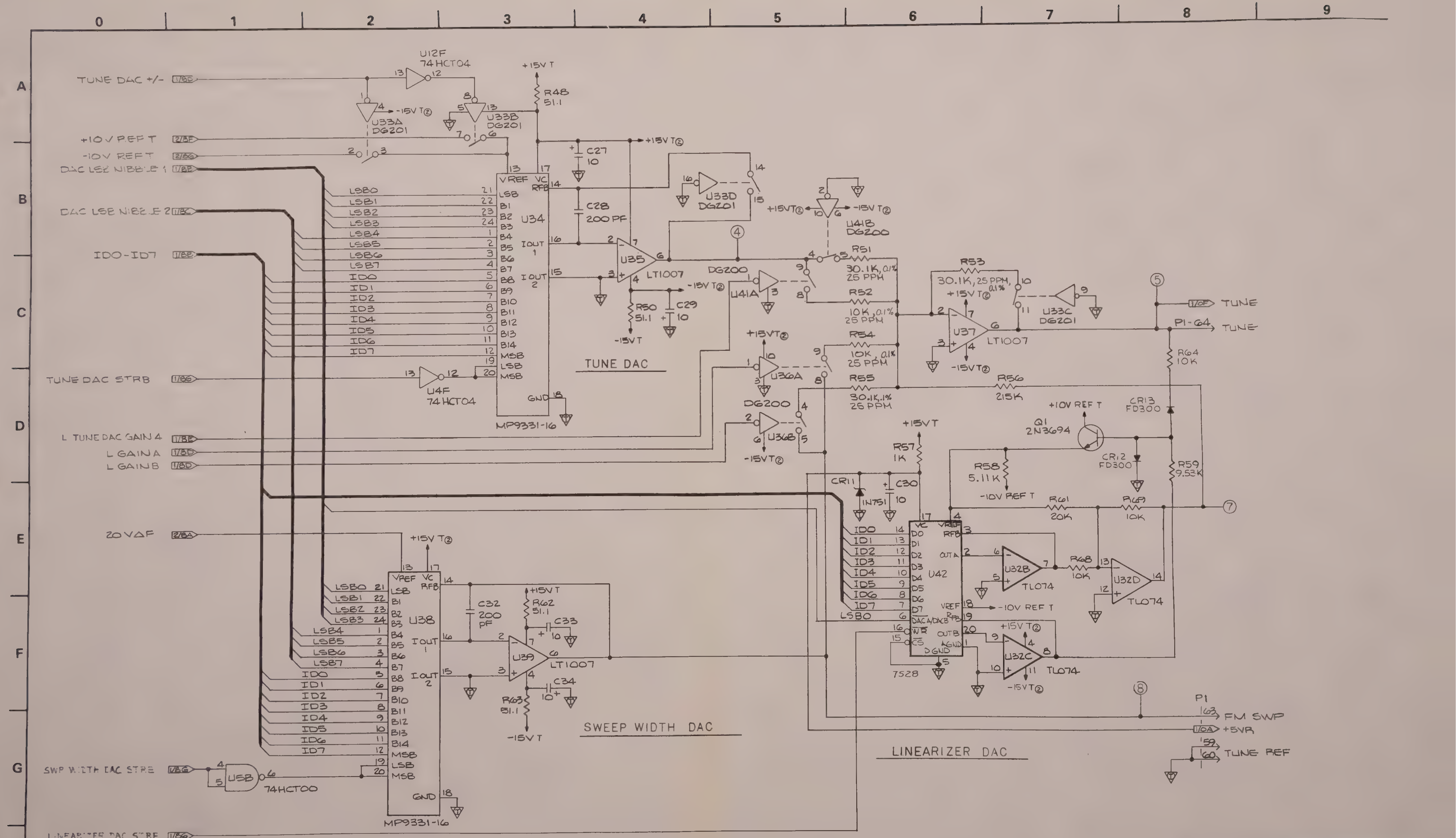
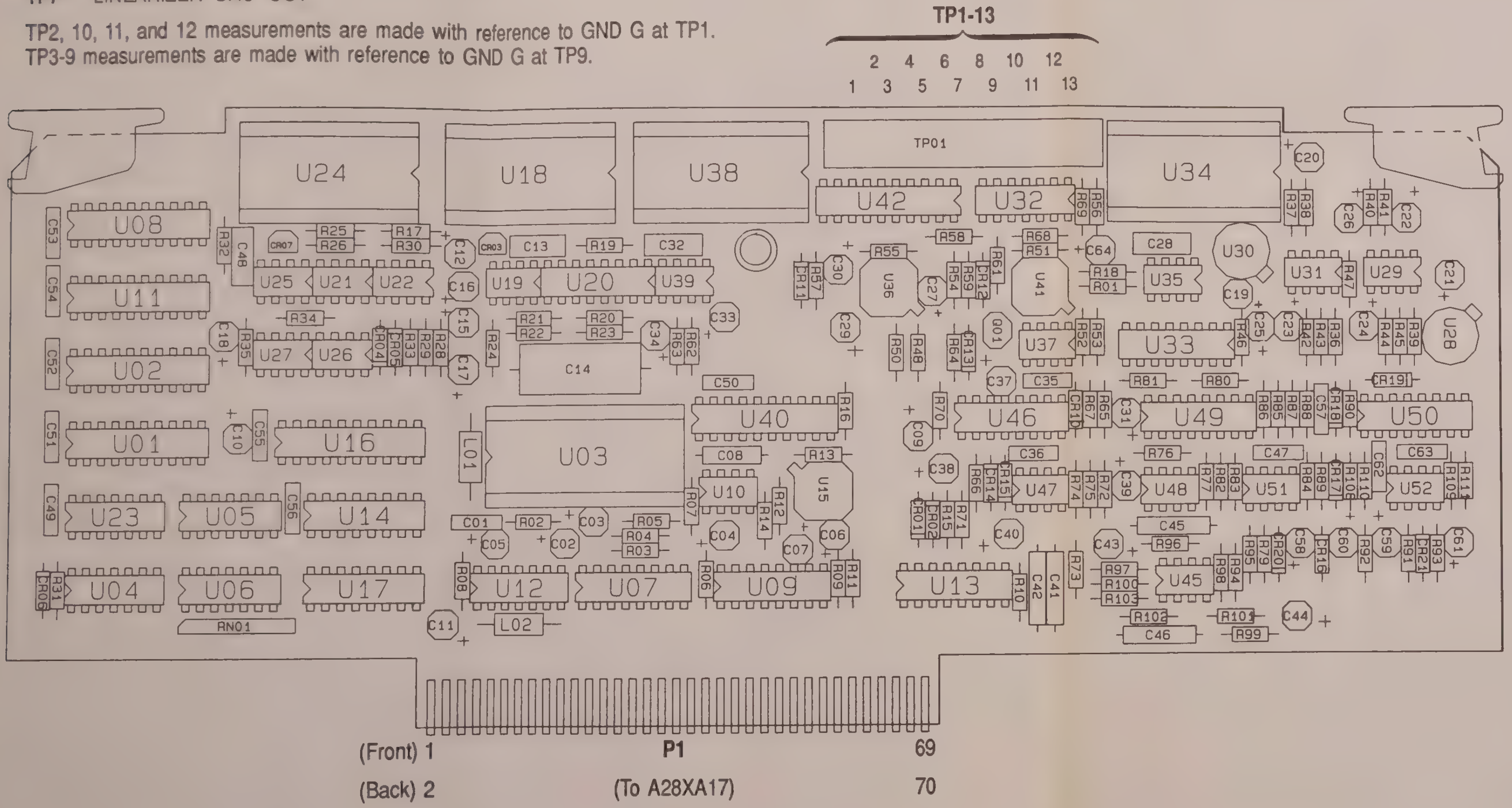

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
TUNE DAC +/-
+10V REF T
-10V REF T
DAC LSB NIBBLE 1
DAC LSB NIBBLE 2
ID0-ID7
TUNE DAC STRB
L TUNE DAC GAIN 4
L GAIN A
L GAIN B
20 VAF
SWP WIDTH DAC STRB
LINEARIZER DAC STRB
U12F
74HCT04
U33A
DG201
U33B
DG201
+15V T
R48
51.1
+15V T②
-15V T②
C27
10
C28
200 PF
U34
MP9331-16
VREF
VC
RFB
LSB
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
B11
B12
B13
B14
MSB
IOUT 1
IOUT 2
GND
LSB0
LSB1
LSB2
LSB3
LSB4
LSB5
LSB6
LSB7
ID0
ID1
ID2
ID3
ID4
ID5
ID6
ID7
U4F
74HCT04
U35
LT1007
R50
51.1
C29
10
-15V T
TUNE DAC
U33D
DG201
U41B
DG200
U41A
DG200
④
R51
30.1K, 0.1%
25 PPM
R52
10K, 0.1%
25 PPM
R53
30.1K, 25 PPM, 0.1%
U33C
DG201
U37
LT1007
⑤
TUNE
P1-64
TUNE
R54
10K, 0.1%
25 PPM
U36A
R55
30.1K, 1%
25 PPM
R56
215K
R64
10K
DG200
U36B
+10V REF T
CR13
FD300
Q1
2N3694
R57
1K
R58
5.11K
CR12
FD300
R59
9.53K
CR11
IN751
C30
10
-10V REF T
R61
20K
R69
10K
⑦
U42
7528
VC
VREF
RFB
D0
D1
D2
D3
D4
D5
D6
D7
OUT A
DAC A/DAC B
WR
CS
OUT B
AGND
DGND
U32B
TL074
R68
10K
U32D
TL074
U32C
TL074
-10V REF T
+5VR
⑧
P1
FM SWP
TUNE REF
U38
MP9331-16
C32
200 PF
R62
51.1
C33
10
U39
LT1007
C34
10
R63
51.1
SWEEP WIDTH DAC
LINEARIZER DAC
U5B
74HCT00

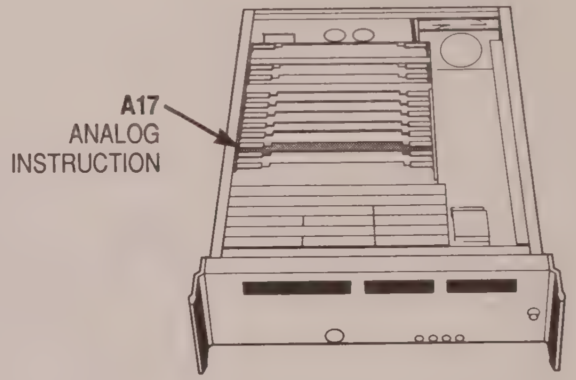
Figure 6K-11. A17 Analog Instruction PCB Schematic Diagram (Sheet 3 of 4)
6700-D-31717-3 (Rev. H)

TEST POINTS

TP1	GND G	**TP8**	FM SWP
TP2	DVM EXT INPUT	**TP9**	GND G
TP3	20V ΔF	**TP10**	V DET
TP4	TUNE DAC OUT	**TP11**	V TH
TP5	TUNE	**TP12**	V dBm
TP6	SWITCH POINT DET OUT	**TP13**	Not Used
TP7	LINEARIZER DAC OUT		

TP2, 10, 11, and 12 measurements are made with reference to GND G at TP1.
TP3-9 measurements are made with reference to GND G at TP9.


TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
TP01
U24
U18
U38
U42
U32
U34
U08
U11
U02
U01
U23
U04
U25
U21
U22
U19
U20
U39
U36
U41
U35
U30
U31
U29
U27
U26
C14
U37
U33
U28
U16
U05
U14
U06
U17
RN01
U03
L01
U40
U46
U49
U50
U10
U15
U47
U48
U51
U52
U12
U07
U09
U13
U45
L02
(Front) 1
P1
69
(Back) 2
(To A28XA17)
70


A17
ANALOG
INSTRUCTION

NOTE:
Leading zeros on component number references may be disregarded.

Copy of Figure 6K-10. A17 Analog Instruction PCB Parts Locater Diagram
6700-D-31717-3 (Rev. G)

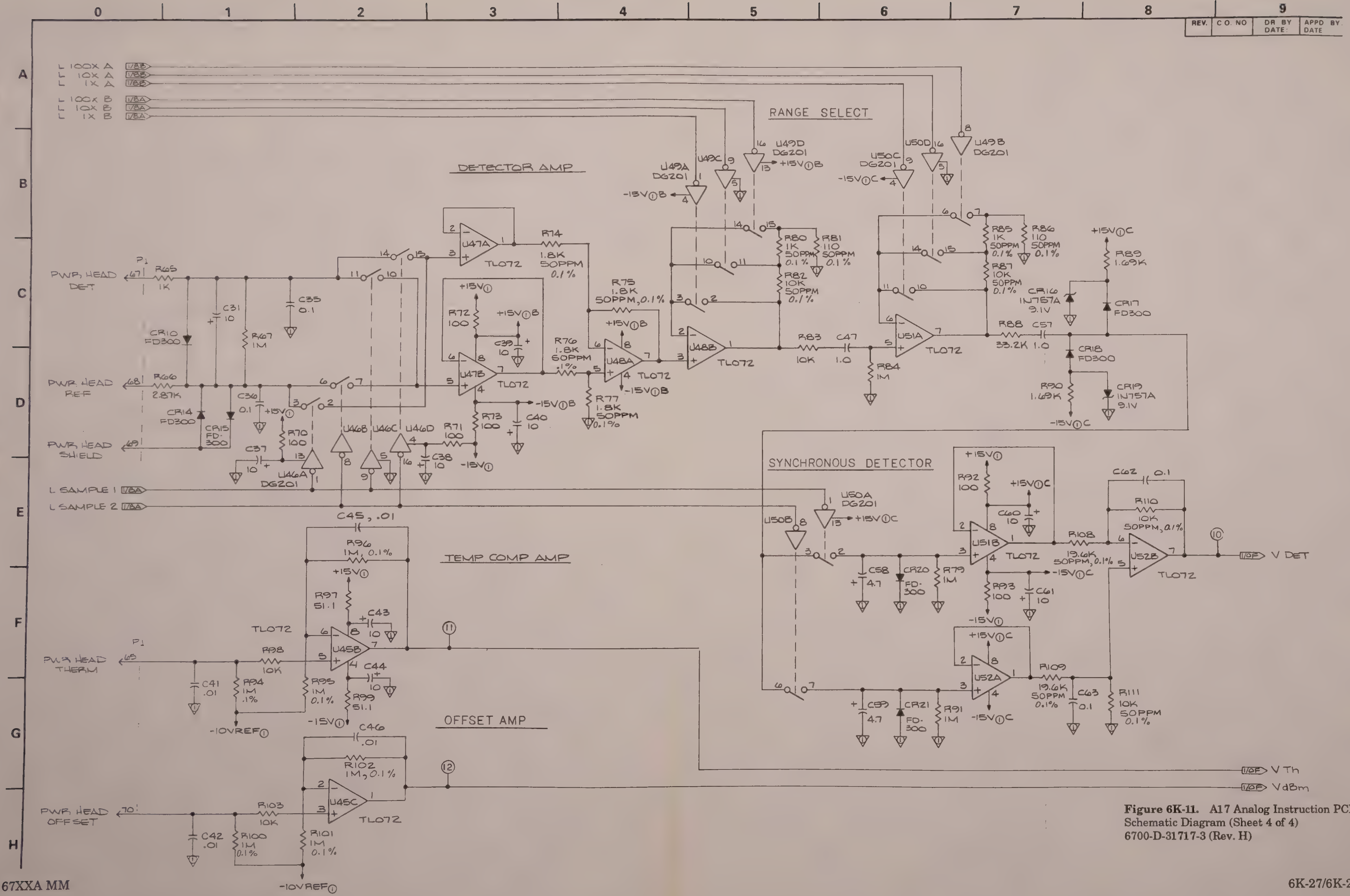

0
1
2
3
4
5
6
7
8
9
REV.
C.O. NO
DR BY DATE
APPD BY DATE
A
B
C
D
E
F
G
H
L 100X A 1/8B
L 10X A 1/8B
L 1X A 1/8B
L 100X B 1/8A
L 10X B 1/8A
L 1X B 1/8A
RANGE SELECT
DETECTOR AMP
U49A DG201
U49C
U49D DG201
+15V①B
-15V①B
U50C DG201
U50D
U49B DG201
-15V①C
U47A TL072
R74 1.8K 50PPM 0.1%
R75 1.8K 50PPM, 0.1%
R76 1.8K 50PPM .1%
R77 1.8K 50PPM 0.1%
U48A TL072
U48B TL072
U47B TL072
R72 100
R73 100
C39 10
C40 10
+15V①
-15V①
R80 1K 50PPM 0.1%
R81 110 50PPM 0.1%
R82 10K 50PPM 0.1%
R83 10K
C47 1.0
R84 1M
U51A TL072
R85 1K 50PPM 0.1%
R86 110 50PPM 0.1%
R87 10K 50PPM 0.1%
+15V①C
R89 1.69K
CR16 1N757A 9.1V
CR17 FD300
R88 33.2K
C57 1.0
CR18 FD300
R90 1.69K
CR19 1N757A 9.1V
-15V①C
P1
PWR HEAD DET 67
R65 1K
C31 10
C35 0.1
CR10 FD300
R67 1M
PWR HEAD REF 68
R66 2.87K
C36 0.1
CR14 FD300
CR15 FD-300
R70 100
PWR HEAD SHIELD 69
C37 10
U46A DG201
U46B
U46C
U46D
R71 100
C38 10
L SAMPLE 1 1/8A
L SAMPLE 2 1/8A
SYNCHRONOUS DETECTOR
U50A DG201
U50B
+15V①C
R92 100
C60 10
U51B TL072
C58 4.7
CR20 FD-300
R79 1M
R93 100
C61 10
R108 19.6K 50PPM, 0.1%
C62 0.1
R110 10K 50PPM, 0.1%
U52B TL072
⑩
1/0F V DET
U52A
R109 19.6K 50PPM 0.1%
C63 0.1
R111 10K 50PPM 0.1%
C59 4.7
CR21 FD-300
R91 1M
TEMP COMP AMP
C45, .01
R96 1M, 0.1%
R97 51.1
C43 10
TL072
U45B
⑪
PWR HEAD THERM 65
R98 10K
C41 .01
R94 1M .1%
R95 1M 0.1%
C44 10
R99 51.1
-10VREF①
OFFSET AMP
C46 .01
R102 1M, 0.1%
⑫
U45C TL072
PWR HEAD OFFSET 70
R103 10K
C42 .01
R100 1M 0.1%
R101 1M 0.1%
1/0F V Th
1/0F VdBm

Figure 6K-11. A17 Analog Instruction PCB Schematic Diagram (Sheet 4 of 4)
6700-D-31717-3 (Rev. H)

6L–YIG DRIVER SUBSYSTEM: A18-A21 PCBs

6L-1 INTRODUCTION

This section contains service information for the YIG driver circuits located on the A18 thru A21 PCBs; see Table 6L-1 below. For information pertaining to the YIG Loop/FM Modulation subsystem, refer to Section 6J–YIG Loop/FM. Refer also to the troubleshooting reference information contained in Sections 6A, 6B, and 6C.

Table 6L-1. YIG Drivers Service Information

Documentation	Reference	Page
A18–A21 PCBs:		
Overall Description	Para. 6L-1.1	6L-1
Detailed Circuit Description	Para. 6L-2	6L-1
Block Diagram	Fig. 6L-1	6L-5
Troubleshooting	Tbl. 6L-2	6L-3
Parts Locator Diagram	Fig. 6L-2	6L-6
Schematic (Sheet 1 of 1)	Fig. 6L-3	6L-7

6L-1.1 YIG Driver PCB Versions

The A18 thru A21YIG Driver PCBs provide the FM driver, main tuning-current driver, and bias supplies for each YIG oscillator assembly. The A18–A21 PCBs are identical in circuit design and differ only in the values and quantity of some components–such as resistors, capacitors, and diodes—used to drive the four different types of YIG oscillator assemblies.

Each type of YIG Driver PCB type is used for a particular frequency band; the YIG Driver PCBs and associated frequency ranges are as follows:

• A18 PCB	2-to-8 GHz
• A19 PCB	8-to-12 GHz
• A20 PCB	12-to-18 GHz
• A21 PCB	18-to-26.5 GHz

Not all A18–A21 YIG Driver PCBs are installed in each model of 67XXA synthesizer. Only those that are appropriate for the frequency band(s) covered by the particular model are installed. For example, A18 thru A20 PCBs are installed in the 6747A; A18 thru A21 are installed in the 6759A, but only the A20 and A21 PCBs are installed in the 6742A.

6L-2 YIG DRIVER PCBS, CIRCUIT DESCRIPTION

The following paragraphs describe the circuitry contained on the A18–A21 YIG Driver PCBs. Refer to the block diagram in Figure 6L-1 and the schematic in Figure 6L-3 for the following circuit description.

6L-2.1 A18–A21 YIG Driver PCB Addressing

Under control of the synthesizer main microprocessor, the YIG Driver Select Latch located on the A17 Analog Instruction PCB selects a specific YIG Driver PCB for each frequency band. The A17 YIG Driver Select Latch pulls the L BAND SEL line of the selected A18–A21 PCB to the low state, as follows:

Selected Driver PCB	A17 Driver Select Line
A18	L YIG DRVR SEL 1
A19	L YIG DRVR SEL 2
A20	L YIG DRVR SEL 3
A21	L YIG DRVR SEL 4

6L-2.2 FM Coil Driver

The FM signal from the A16 FM PCB is routed to the input of the differential receiver amplifier,U1. The output of U1 is fed to filter/amplifier U3 via analog switch U2C. This filter stage improves the YIG loop frequency response. Op amp U3 also drives driver transistors, Q1 and Q2. The current through the FM coil of the YIG oscillator located on the RF deck is sensed by the FM sense resistor (R7); this signal is fed back to the input of U3, by resistor R9.

The FM feedback signal developed across R7 also goes to buffer amplifier U4A. The output of U4 goes to the main tuning coil control amplifier (U6) when the H CW FILTER control line is high. This cancels the magnetic coupling between the FM coil and the main coil, which produces a linear sweep (for sweep widths less than 50 MHz).

6L-2.3 Main Tuning Coil Driver

The TUNE output of the A17 Analog Instruction PCB is either a dc voltage that represents the tuning current needed for the selected YIG oscillator (CW mode) or a 0 to –10V ramp signal (sweep mode). This signal is input to the differential receiver amplifier U4C. The output of U4C goes analog switches U5B/C to the input of control amplifier U6; note that switches U5B/C are closed when the YIG driver PCB is selected. A +10V reference voltage from the A17 PCB is input to the U4 differential receiver.

This voltage is used as a reference for all of the control drive signals developed by the YIG Driver PCB.

The TUNE signal and +10V reference are summed by the tuning coil driver control amplifier, U6. The output of U6 goes to the input of driver amplifier Q4, which drives the tuning coil drive amplifier comprised of Q5 and Q7. This amplifier furnishes the main tuning coil current for the associated YIG oscillator assembly. The current through the main tuning coil is sensed by the main tuning coil sense resistor (R29); this signal is fed back to the input of U6, by R28.

During fast sweeps—or stepping operations in the GPIB mode—the main tuning coil requires more voltage to speed up the current change in the main tuning coil. The voltage switch circuit comprised of Q6, Q8 and Q9 furnishes –43V to the main tuning coil drive amplifier on demand. This switching occurs whenever the voltage drive signal to the coil goes below approximately –12.5V.

When operating in the CW mode or with sweep widths less than 50 MHz, control line H CW FILTER is in the high state which opens analog switch U5A and closes switch U5D. This connects the filter network comprised of R36 and C23/24 into the feedback path of control amplifier (U6); it also connects the feedback path from the output of Q5 to the input of U6. The feedback filter network reduces the overall bandwidth of the main tuning coil driver amplifier from approximately 6 kHz to 30 Hz. This reduced bandwidth improves the residual FM performance in the CW and narrow band sweep modes.

For fast broadband sweeps, analog switch U5A/ is closed and U5D is opened. This disconnects the feedback paths from the input of control amplifier U6, which provides wider driver circuit bandwidth. The switching of the H CW FILTER control line is controlled by the main microprocessor and is completely automatic.

6L-2.4 Bias Supply Driver Circuits.

Integrated switch U7 provides the switching logic for the bias supply driver circuits. The A18 PCB is the only YIG Driver PCB that includes driver circuits for the –5V YIG bias supply and for the Frequency Downconverter assembly.

Switch U7 is controlled by the L RF OFF and L BAND SEL lines from the A17 PCB. When L RF OFF is high and L BAND SEL is low, +10V from the output of U4B is connected via U7 to the input of U8A. This causes driver transistor Q11 to supply +15V bias to the YIG oscillator assembly. This also causes U9 to turn on the –5V YIG bias driver, Q13 (A18 only).

Switch U7 also connects +10V to the input of U8B, which turns on driver transistor Q12. This driver circuit supplies +15V to the A31 Multiplier/Power Amplifier assembly. This circuit is identical to the driver circuits of the YIG bias supplies.

When the RF OUTPUT is turned off via the front panel or a frequency is selected in another band, U7 connects 0V to the inputs of the bias supply driver circuits. This turns the driver circuits off, thereby turning off the associated YIG oscillator.

The A18 PCB also contains a driver circuit that supplies +15V to the Frequency Downconverter assembly. When the 67XXA is operating in the 0.01–2 GHz band, the main microprocessor sets control line L DOWN CONV SEL low (via the A29 Rear Panel Interface PCB). This causes analog switch U2 to connect +10V to the input of U10. The output of U10 turns on driver transistor Q16, which supplies +15V to the frequency downconverter assembly.

6L-3 YIG DRIVER PCBS TROUBLESHOOTING

Table 6L-2 contains the list of 67XXA error codes that pertain to the A18–A21 YIG Driver PCBs. This table also includes troubleshooting procedures and suggestions for these PCBs. Refer also to the troubleshooting reference information contained in sections 6A, 6B, and 6C.

6L-4 YIG DRIVER PCBS SERVICE SHEETS

Table 6L-1 lists the block diagrams, schematic diagrams, and parts locator diagrams for the A18– and A21 PCBs that are contained in this section.

Table 6L-2. A18–A21 YIG Driver PCBs Troubleshooting (1 of 2)

Error Code	Description	Remarks/Possible Problem Area
	RF tests ***NOTE*** The following error codes indicate a possible problem on the RF microwave deck and/or A18–A21 PCBs. They may not be applicable to all 67XXA models because of different RF microwave deck configurations. Refer to Table 6Q-2 for the RF microwave deck configuration by model number. The first two digits of the error code indicate the number of the YIG Driver PCB (A18 thru A21) associated with the frequency band. The third digit is the frequency band number. The fourth digit is the type of test.	Refer to Section 6Q–Microwave Deck for detailed RF troubleshooting procedures.
E18-01	Unleveled Error, Band 0	The downconverter output is unleveled. The Band 1 Control Modulator or modulator drive is the most probable cause.
E18-02	No RF Error, Band 0	Either the Downconverter is defective or there is no output from the A5 Reference Oscillator PCB to the Downconverter.
E18-03	FM Path Error, Band 0	The FM coil driver on the A18 PCB is defective.
E18-11	Unleveled Error, Band 1	The Band 1 Control Modulator or driver is defective.
E18-12	No RF Error, Band 1	The Band 1 Control Modulator or YIG-tuned oscillator is defective.
E18-13	FM Path Error, Band 1	The FM coil driver on the A18 PCB is defective.
E19-21	Unleveled Error, Band 2	The Band 2 Control Modulator or driver is defective.
E19-22	No RF Error, Band 2	The Band 2 Control Modulator or YIG-tuned oscillator is defective.
E19-23	FM Path Error, Band 2	The FM coil driver on the A19 PCB is defective.
E20-31	Unleveled Error, Band 3	The Band 3 Control Modulator or driver is defective.

Table 6CL-2. A18–A21 YIG Driver PCBs Troubleshooting (2 of 2)

Error Code	Description	Remarks/Possible Problem Area
E20-32	No RF Error, Band 3	The Band 3 Control Modulator or YIG-tuned oscillator is defective.
E20-33	FM Path Error, Band 3	The FM coil driver on the A20 PCB is defective.
E21-41	Unleveled Error, Band 4	The Band 4 Control Modulator or driver is defective.
E21-42	No RF Error, Band 4	The Band 4 Control Modulator or YIG-tuned oscillator is defective.
E21-43	FM Path Error, Band 4	The FM coil driver on the A21 PCB is defective.
E21-51	Unleveled Error, Band 5	The Band 3 Control Modulator or driver is defective.
E21-52	No RF Error, Band 5	The Band 3 Control Modulator, YIG-tuned oscillator, or ffrequency doubler/ amplifier is defective.
E21-53	FM Path Error, Band 5	The FM coil driver on the A20 PCB is defective.

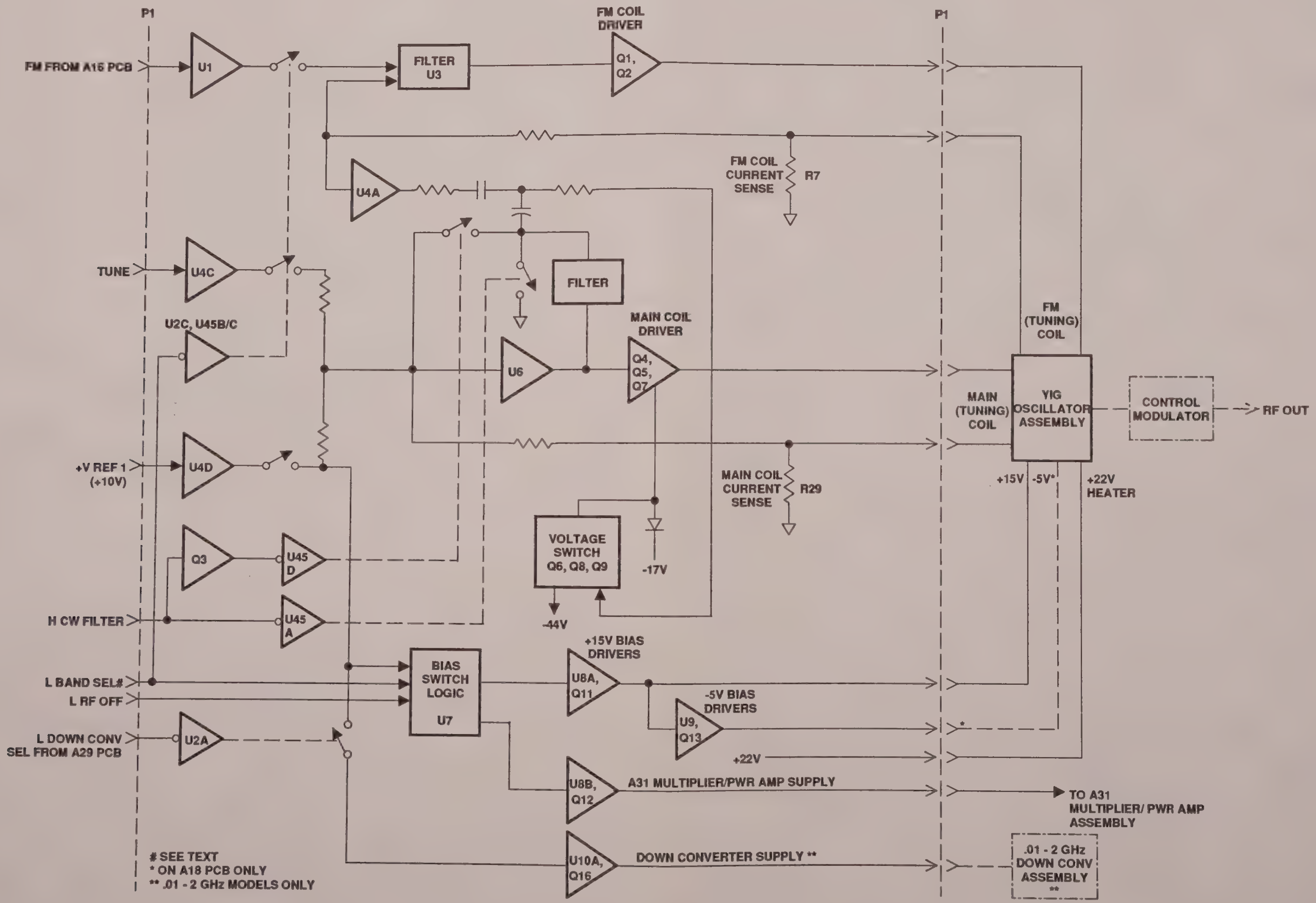
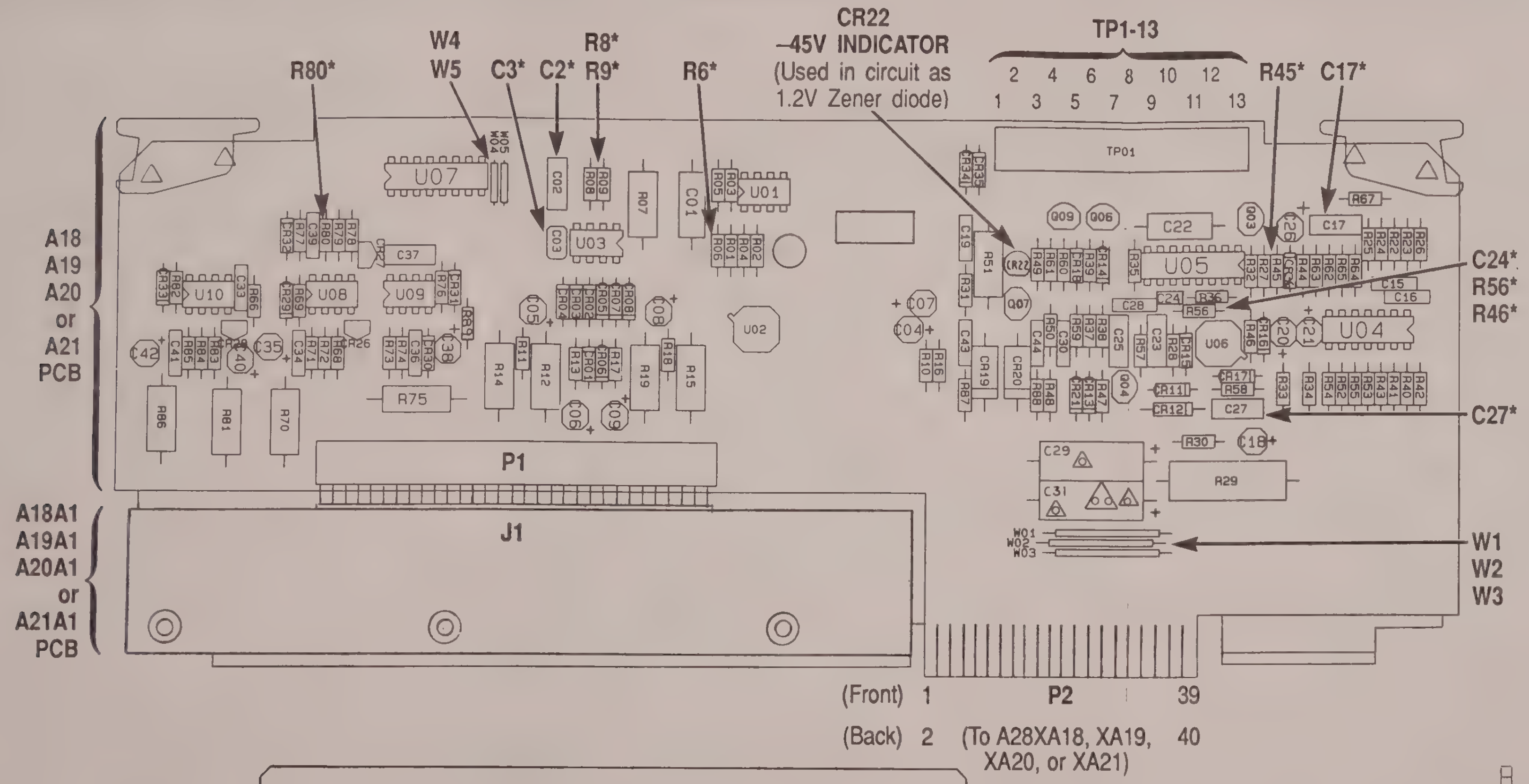

P1
FM COIL DRIVER
P1
FM FROM A16 PCB
U1
FILTER U3
Q1, Q2
U4A
FM COIL CURRENT SENSE
R7
TUNE
U4C
FILTER
U2C, U45B/C
MAIN COIL DRIVER
U6
Q4, Q5, Q7
FM (TUNING) COIL
MAIN (TUNING) COIL
YIG OSCILLATOR ASSEMBLY
CONTROL MODULATOR
RF OUT
+V REF 1 (+10V)
U4D
MAIN COIL CURRENT SENSE
R29
+15V
-5V*
+22V HEATER
Q3
U45 D
VOLTAGE SWITCH Q6, Q8, Q9
-17V
H CW FILTER
U45 A
-44V
+15V BIAS DRIVERS
L BAND SEL#
L RF OFF
BIAS SWITCH LOGIC U7
U8A, Q11
-5V BIAS DRIVERS
U9, Q13
*
L DOWN CONV SEL FROM A29 PCB
U2A
+22V
U8B, Q12
A31 MULTIPLIER/PWR AMP SUPPLY
TO A31 MULTIPLIER/ PWR AMP ASSEMBLY
U10A, Q16
DOWN CONVERTER SUPPLY **
.01 - 2 GHz DOWN CONV ASSEMBLY **
# SEE TEXT
* ON A18 PCB ONLY
** .01 - 2 GHz MODELS ONLY

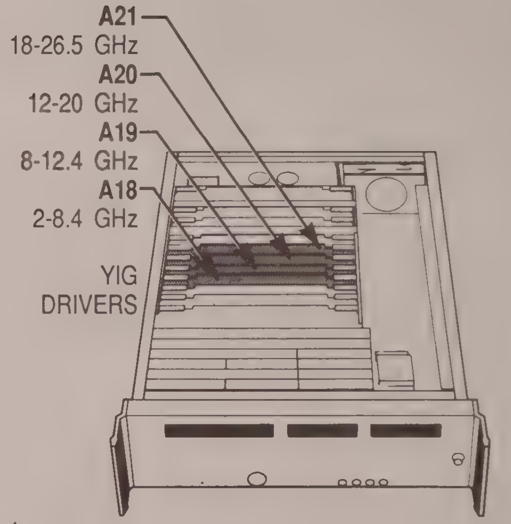
Figure 6L-1. Overall Block Diagram of A18–A21 YIG Driver PCBs

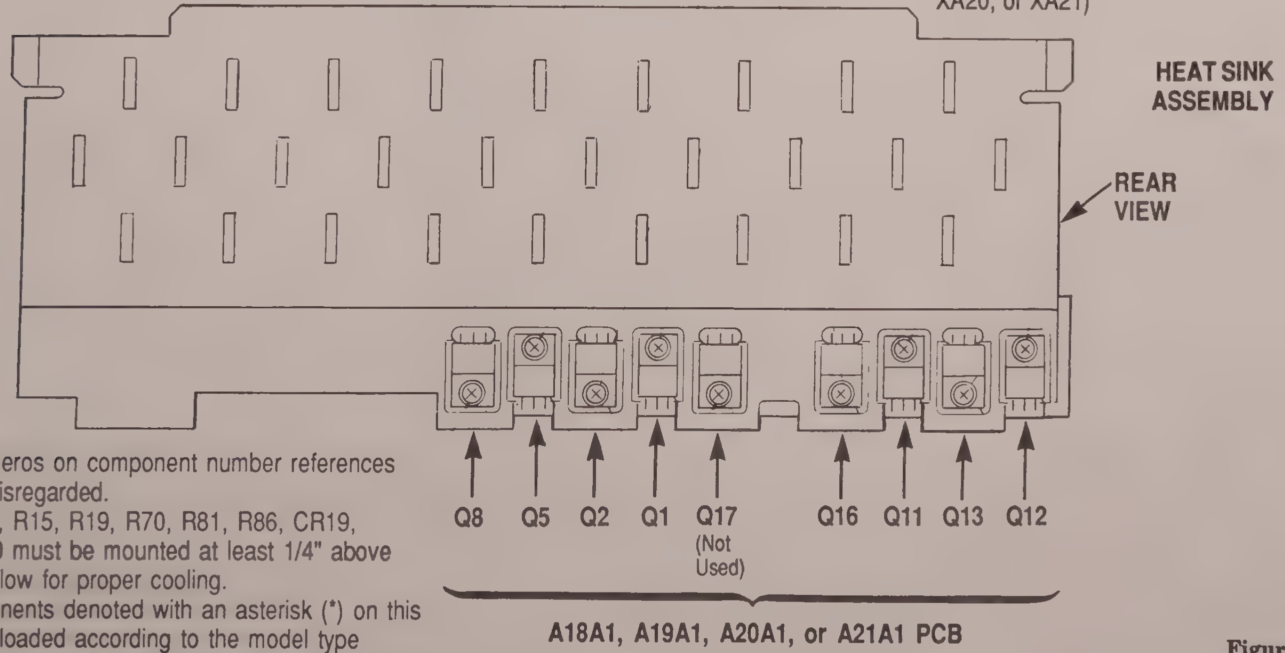

R80*
W4
W5
C3*
C2*
R8*
R9*
R6*
CR22
–45V INDICATOR
(Used in circuit as
1.2V Zener diode)
TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
R45*
C17*
C24*
R56*
R46*
C27*
W1
W2
W3
A18
A19
A20
or
A21
PCB
A18A1
A19A1
A20A1
or
A21A1
PCB
P1
J1
(Front) 1
P2
39
(Back) 2
(To A28XA18, XA19,
XA20, or XA21)
40

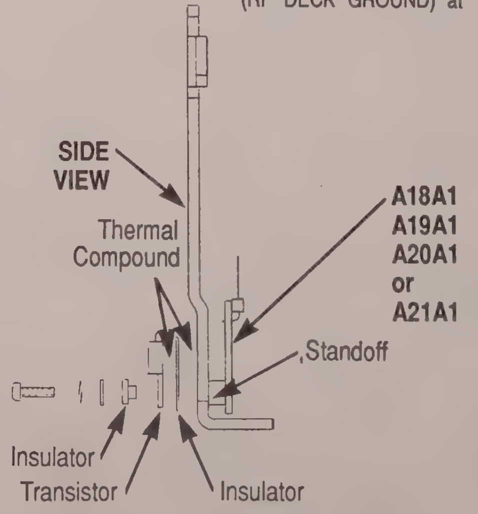
TEST POINTS

TP1	FM COIL CIRCUITS GND (GND G)
TP2	FM COIL (+)
TP3	FM COIL (–)
TP4	MAIN COIL (+)
TP5	MAIN COIL (–)
TP6	MAIN COIL CIRCUITS GROUND (GND G)
TP7	+22V HEATER
TP8	+15V AMP
TP9	+15V DOWN CONV
TP10	–5V BIAS
TP11	BIAS SENSE (RF DECK GROUND)
TP12	+15V BIAS
TP13	Not Used

TP2 and TP3 measurements are made with reference to FM COIL CIRCUITS GROUND (GND G) at TP1.
TP4 and TP5 measurements are made with reference to MAIN COIL CIRCUITS GROUND (GND G) at TP6.
TP7-12 measurements are made with reference to BIAS SENSE (RF DECK GROUND) at TP11.


A21
18-26.5 GHz
A20
12-20 GHz
A19
8-12.4 GHz
A18
2-8.4 GHz
YIG
DRIVERS


HEAT SINK
ASSEMBLY
REAR
VIEW
Q8
Q5
Q2
Q1
Q17
(Not
Used)
Q16
Q11
Q13
Q12
A18A1, A19A1, A20A1, or A21A1 PCB

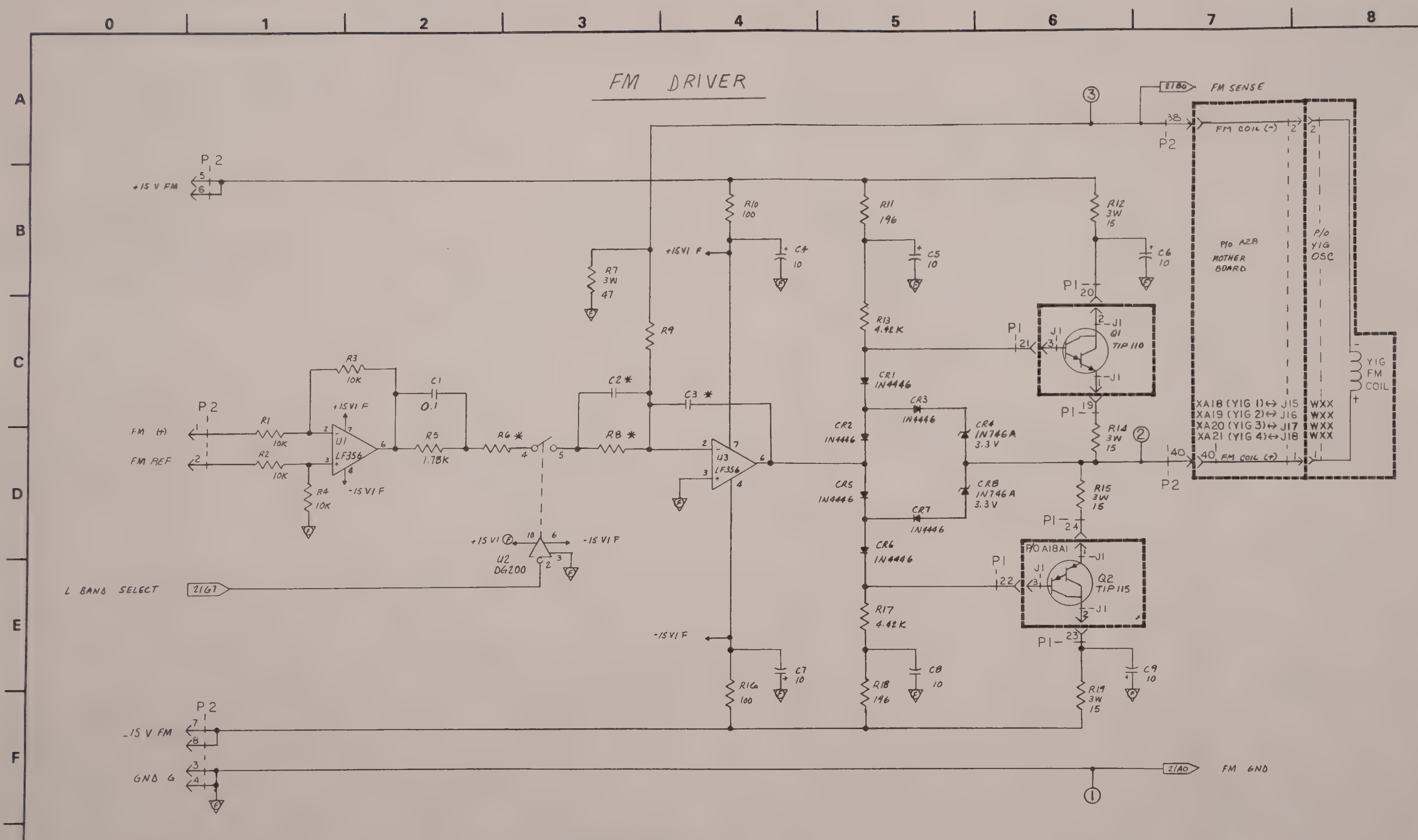

SIDE
VIEW
Thermal
Compound
A18A1
A19A1
A20A1
or
A21A1
Standoff
Insulator
Transistor
Insulator

NOTES:

1. Leading zeros on component number references may be disregarded.
2. R12, R14, R15, R19, R70, R81, R86, CR19, and CR20 must be mounted at least 1/4" above PCB to allow for proper cooling.
3. All components denoted with an asterisk (*) on this page are loaded according to the model type frequency range; see the tables on each schematic sheet for the appropriate values.

Figure 6L-2. A18–21 YIG Driver PCB Parts Locator Diagram

A18 PCB (2-8 GHz): 6700-D-31718-4 (Rev. B)
A18 PCB (2-8 GHz): 6700-D-31718-9 (Rev. B)
A19 PCB (8-12.4 GHz): 6700-D-31718-5 (Rev. B)
A20 PCB (12.4-20 GHz): 6700-D-31718-6 (Rev. B)
A21 PCB (20-26.5 GHz): 6700-D-31718-7 (Rev. B)
A21 PCB (18-26.5 GHz): 6700-D-31718-8 (Rev. B)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
FM DRIVER
P2
+15 V FM
5
6
FM (+)
FM REF
R1 10K
R2 10K
R3 10K
R4 10K
U1 LF356
+15VI F
-15VI F
C1 0.1
R5 1.78K
R6 *
C2 *
R7 3W 47
R9
R8 *
C3 *
U2 DG200
+15VI F
-15VI F
L BAND SELECT
2IG7
U3 LF356
R10 100
+15VI F
C4 10
-15VI F
R16 100
C7 10
R11 196
C5 10
R13 4.42K
CR1 1N4446
CR2 1N4446
CR3 1N4446
CR4 1N746A 3.3 V
CR5 1N4446
CR7 1N4446
CR8 1N746A 3.3 V
CR6 1N4446
R17 4.42K
R18 196
C8 10
R12 3W 15
C6 10
P1 20
P1 21
J1
Q1 TIP 110
P1 19
R14 3W 15
②
R15 3W 15
P1 24
P0 A18A1
Q2 TIP 115
P1 22
P1 23
R19 3W 15
C9 10
-15 V FM
7
8
GND G
3
4
③
8IB0
FM SENSE
38
P2
FM COIL (-)
P/o A28 MOTHER BOARD
P/o YIG OSC
YIG FM COIL
XA18 (YIG 1)↔ J15 WXX
XA19 (YIG 2)↔ J16 WXX
XA20 (YIG 3)↔ J17 WXX
XA21 (YIG 4)↔ J18 WXX
40
FM COIL (+)
P2
2IA0
FM GND
①

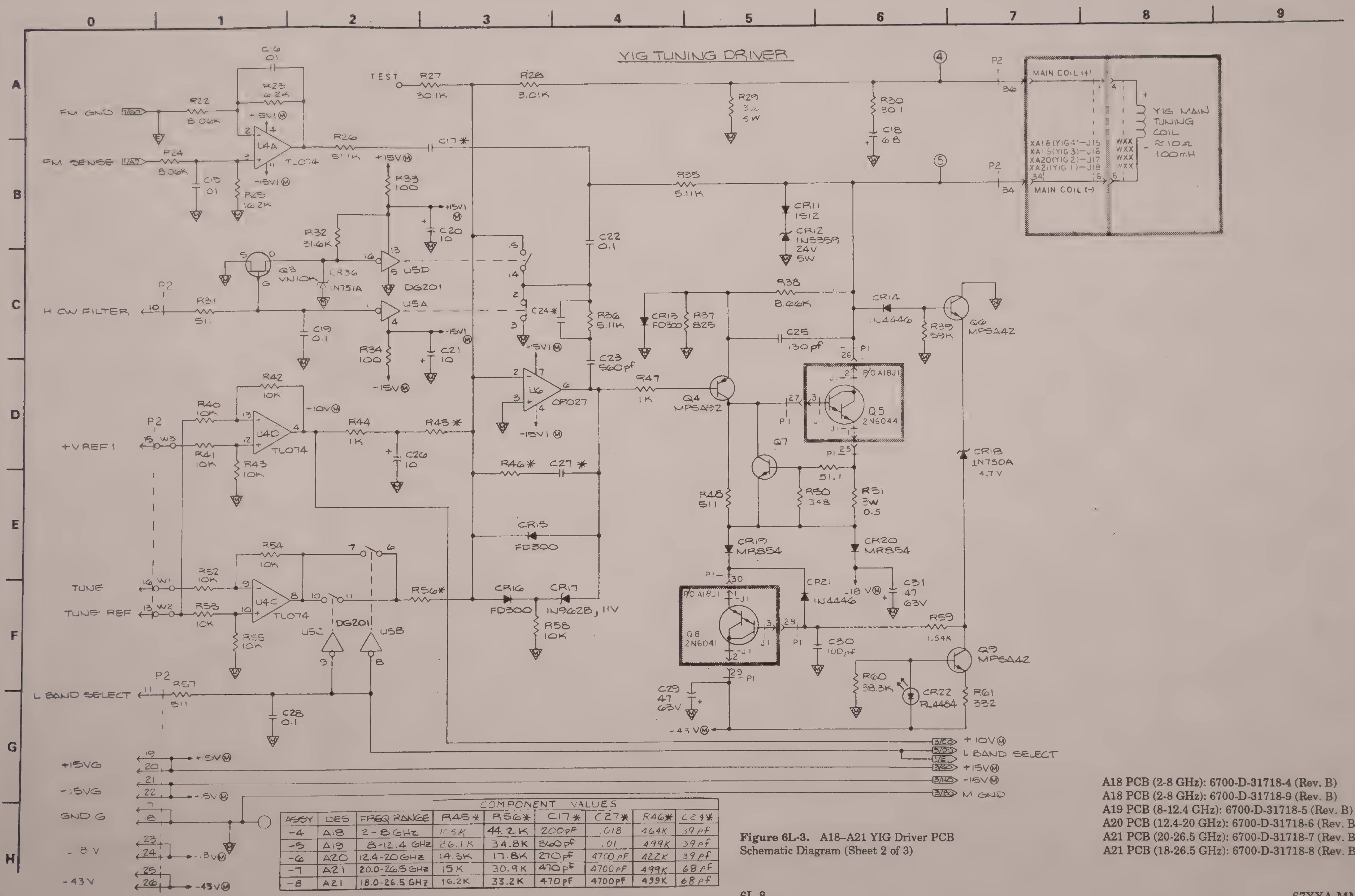
A18 YIG DRIVER SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUNDS: B F A
4. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK:
   C2*, C3*, C17*, C24*, C27*, R6*, R8*, R9*, R46*, R56*, R80*,
5. TEST POINTS ARE DENOTED AS: ②
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. SUBASSEMBLY BORDERS ARE DENOTED AS:
8. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR26, CR27, R28, R62-65, Q3, U1-U7
9. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C44 CR36 P1 Q9 R88 TP1 U10 W5	(See factory-selected resistor tables.)

			COMPONENT VALUES				
ASSY	DES	FREQ RANGE	R6 *	R8 *	R9 *	C2 *	C3 *
-4	A18	2-8 GHz	12.7K	1.87K	12.4K	1000pF	10pF
-5	A19	8-12.4 GHz	12.1K	2.74K	12.4K	680pF	10pF
-6	A20	12.4-20 GHz	12.7K	1.87K	8.25K	1000pF	15pF
-7	A21	20-26.5 GHz	12.7K	1.87K	10.2K	1000pF	15pF
-8	A21	18-26.5 GHz	12.7K	1.87K	10.2K	1000pF	15pF

Figure 6L-3. A18–A21 YIG Driver PCB Schematic Diagram (Sheet 1 of 3)
A18 PCB (2-8 GHz): 6700-D-31718-4 (Rev. B)
A18 PCB (2-8 GHz): 6700-D-31718-9 (Rev. B)
A19 PCB (8-12.4 GHz): 6700-D-31718-5 (Rev. B)
A20 PCB (12.4-20 GHz): 6700-D-31718-6 (Rev. B)
A21 PCB (20-26.5 GHz): 6700-D-31718-7 (Rev. B)
A21 PCB (18-26.5 GHz): 6700-D-31718-8 (Rev. B)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
YIG TUNING DRIVER
C16 .01
R23 16.2K
R22 8.06K
FM GND
FM SENSE
R24 8.06K
C15 .01
R25 16.2K
+5V1 Ⓜ
-15V1 Ⓜ
U4A
TL074
TEST
R27 30.1K
R28 3.01K
R26 511K
C17 *
+15V Ⓜ
R29 3Ω 5W
R30 30.1
C18 68
④
⑤
P2
36
34
MAIN COIL (+)
MAIN COIL (-)
XA18 (YIG 4)—J15
XA19 (YIG 3)—J16
XA20 (YIG 2)—J17
XA21 (YIG 1)—J18
WXX
YIG MAIN TUNING COIL ≈10Ω 100mH
R35 5.11K
CR11 1S12
CR12 1N5359 24V 5W
R33 100
+15V1 Ⓜ
C20 10
R32 31.6K
Q3 VN10K
S
D
G
CR36 1N751A
U5D
DG201
U5A
H CW FILTER
R31 511
C19 0.1
R34 100
-15V1 Ⓜ
C21 10
-15V Ⓜ
C22 0.1
C24 *
R36 5.11K
C23 560pF
U6
OP027
+15V1 Ⓜ
-15V1 Ⓜ
R38 8.66K
CR13 FD300
R37 825
C25 130pF
CR14 1N4446
R39 59K
Q6 MPSA42
R47 1K
Q4 MPSA92
Q5 2N6044
P/O A18J1
Q7
R50 348
R51 3W 0.5
51.1
R48 511
CR18 1N750A 4.7V
R42 10K
R40 10K
R41 10K
R43 10K
U4D
TL074
+10V Ⓜ
+VREF1
W3
R44 1K
R45 *
C26 10
R46 *
C27 *
CR15 FD300
R54 10K
R52 10K
R53 10K
U4C
TL074
TUNE
TUNE REF
W1
W2
R55 10K
U5C
U5B
DG201
R56 *
CR16 FD300
CR17 1N962B, 11V
R58 10K
CR19 MR854
CR20 MR854
CR21 1N4446
-18V Ⓜ
C31 47 63V
Q8 2N6041
P/O A18J1
C30 100pF
R59 1.54K
Q9 MPSA42
R60 38.3K
CR22 RL4484
R61 332
C29 47 63V
-43V Ⓜ
L BAND SELECT
R57 511
C28 0.1
+10V Ⓜ
L BAND SELECT
+15V Ⓜ
-15V Ⓜ
M GND
+15VG
-15VG
GND G
-8V
-43V
-.8V Ⓜ
-43V Ⓜ

ASSY	DES	FREQ RANGE	COMPONENT VALUES					
			R45*	R56*	C17*	C27*	R46*	C24*
-4	A18	2 - 8 GHz	16.5K	44.2K	200pF	.018	464K	39 pf
-5	A19	8-12.4 GHz	26.1K	34.8K	360pf	.01	499K	39 pf
-6	A20	12.4-20 GHz	14.3K	17.8K	270pf	4700 pF	422K	39 pf
-7	A21	20.0-26.5 GHz	15K	30.9K	470pF	4700 pF	499K	68 pf
-8	A21	18.0-26.5 GHz	16.2K	33.2K	470pF	4700pF	499K	68 pf

Figure 6L-3. A18–A21 YIG Driver PCB Schematic Diagram (Sheet 2 of 3)

A18 PCB (2-8 GHz): 6700-D-31718-4 (Rev. B)
A18 PCB (2-8 GHz): 6700-D-31718-9 (Rev. B)
A19 PCB (8-12.4 GHz): 6700-D-31718-5 (Rev. B)
A20 PCB (12.4-20 GHz): 6700-D-31718-6 (Rev. B)
A21 PCB (20-26.5 GHz): 6700-D-31718-7 (Rev. B)
A21 PCB (18-26.5 GHz): 6700-D-31718-8 (Rev. B)

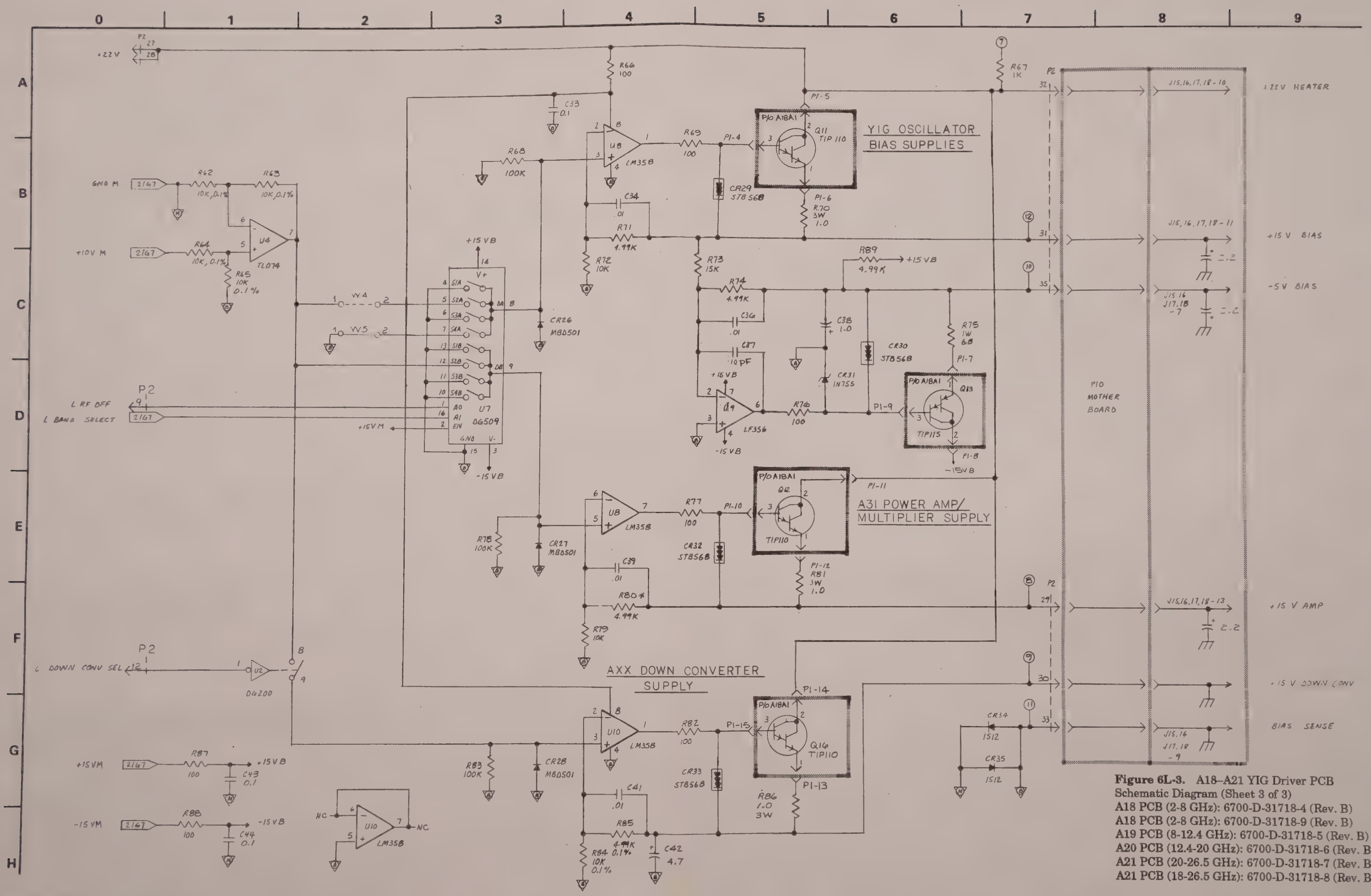

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
+22V
P2
27
28
R66
100
C33
0.1
R67
1K
+22V HEATER
J15,16,17,18-10
P1-5
P/o A18A1
Q11
TIP 110
YIG OSCILLATOR
BIAS SUPPLIES
U8
LM358
R68
100K
R69
100
P1-4
P1-6
R70
3W
1.0
CR29
STB568
GND M
R62
10K, 0.1%
R63
10K, 0.1%
U4
TL074
+10V M
R64
10K, 0.1%
R65
10K
0.1%
C34
.01
R71
4.99K
R72
10K
+15V BIAS
J15,16,17,18-11
2.2
R73
15K
R89
4.99K
+15VB
R74
4.99K
-5V BIAS
J15,16
J17,18
-7
C36
.01
C37
10 PF
C38
1.0
CR30
STB568
R75
1W
68
P1-7
CR31
IN755
U9
LF356
-15VB
R76
100
P1-9
Q13
TIP115
P1-8
W4
W5
U7
DG509
S1A
S2A
S3A
S4A
S1B
S2B
S3B
S4B
DA
DB
A0
A1
EN
GND
V-
+15VB
+15VM
CR26
MBD501
P2
L RF OFF
L BAND SELECT
P10
MOTHER
BOARD
P1-11
Q12
TIP110
A31 POWER AMP/
MULTIPLIER SUPPLY
R77
100
P1-10
CR32
STB568
P1-12
R81
3W
1.0
R78
100K
CR27
MBD501
C39
.01
R80*
4.99K
R79
10K
+15V AMP
J15,16,17,18-13
L DOWN CONV SEL
U2
DG200
AXX DOWN CONVERTER
SUPPLY
P1-14
+15V DOWN CONV
CR34
1S12
CR35
1S12
BIAS SENSE
J15,16
J17,18
-9
U10
LM358
R82
100
P1-15
Q16
TIP110
CR33
STB568
P1-13
R86
1.0
3W
R83
100K
CR28
MBD501
C41
.01
R85
4.99K 0.1%
R84
10K
0.1%
C42
4.7
+15VM
R87
100
C43
0.1
-15VM
R88
100
C44
0.1
NC
LM358

Figure 6L-3. A18–A21 YIG Driver PCB Schematic Diagram (Sheet 3 of 3)
A18 PCB (2-8 GHz): 6700-D-31718-4 (Rev. B)
A18 PCB (2-8 GHz): 6700-D-31718-9 (Rev. B)
A19 PCB (8-12.4 GHz): 6700-D-31718-5 (Rev. B)
A20 PCB (12.4-20 GHz): 6700-D-31718-6 (Rev. B)
A21 PCB (20-26.5 GHz): 6700-D-31718-7 (Rev. B)
A21 PCB (18-26.5 GHz): 6700-D-31718-8 (Rev. B)

6M–ALC / PULSE MODULATION SUBSYSTEM: A15, A13, AND A29 PCBS

6M-1 ALC (AUTOMATIC LEVEL CONTROL) AND PULSE MODULATION PCBS AND ASSEMBLIES

This section contains service information for the ALC loop and Pulse Modulation circuits located on the A15, A13, and A29 PCBs; see Table 6N-1 below. Refer also to Section 6Q-Microwave Deck and to the general reference information in Sections 6A, 6B, and 6C.

Table 6M-1. ALC Loop / Pulse Modulation Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6M-1.1	6M-1
Block Diagram	Fig. 6M-1	6M-3
Troubleshooting	Tbl. 6M-2	6M-13
PCB LEVEL		
A15 ALC PCB		
Detailed Circuit Description	Para. 6M-1.2	6M-1
Block Diagram	Fig. 6M-2	6M-4
Troubleshooting	Tbl. 6M-2	6M-13
Parts Locator Diagram	Fig. 6M-5	6M-14
Schematic (Sheet 1 of 5)	Fig. 6M-6	6M-15
A13 PULSE GEN PCB		
Detailed Circuit Description	Para. 6M-1.3	6M-7
Block Diagram	Fig. 6M-3	6M-9
Troubleshooting	Tbl. 6M-2	6M-13
Parts Locator Diagram	Fig. 6M-7	6M-20
Schematic (Sheet 1 of 4)	Fig. 6M-8	6M-21
P/O A29 REAR PANEL INTERFACE PCB		
Detailed Circuit Description	Para. 6M-1.4	6M-11
Block Diagram	Fig. 6M-4	6M-10
Troubleshooting	Tbl. 6M-2	6M-13
Parts Locator Diagram	Refer to Section 6F	
Schematic Diagram	Refer to Section 6F	

6M-1.1 Overview of ALC Loop Operation

The ALC loop controls the RF output power level through a feedback system. It also provides amplitude modulation capabilities and control of the RF during pulse operation. Most of the major ALC circuits are located on the A15 PCB; other circuits and components of the ALC loop are located on the A29 Rear Panel Interface PCB and on the microwave deck. Refer to Figure 6M-1, which is an overall block diagram of these circuits.

All major circuits of the ALC loop are controlled by the synthesizer main microprocessor. When an RF output power level is selected from either the front panel or via the GPIB, the microprocessor sets the ALC level reference voltage to a value equal to the desired RF output level voltage. This reference voltage is compared to a sample of the RF output from the Level Detector, and an error signal is developed if they are not equal. This signal is amplified/processed by the ALC level amplifier and then fed to the PIN drivers. This causes the PIN modulators to change the level of the RF signal accordingly. This process causes the RF output voltage to be set equal to the ALC reference voltage.

For AM modulation operation, the signal from the external AM modulation source is summed with the internal ALC reference voltage. Due to the action of the ALC loop, the RF output changes with the reference voltage so that the RF envelope duplicates the AM signal.

6M-1.2 A15 ALC PCB Functional Description

The major ALC circuits are located on the A15 PCB; these circuits are discussed in the following paragraphs. Refer to the overall block diagram of the A15 PCB, Figure 6M-2, and also to the schematic diagram, Figure 6M-6 (as necessary).

a. ***Microprocessor Control***

The ALC internal data bus is buffered from the main processor data bus by latch U1. Whenever the ALC board is addressed via the LPA17 line, the data on the microprocessor bus is transferred by U1 to the internal data bus. The LPA17 line also enables the ALC address decoder (U2), which decodes address lines PA0–PA2. The decoder circuit then strobes the addressed ALC data latch(es) or digital-to-analog converter (DAC), thus loading the instructions/data from the data bus into the addressed device.

b. ***ALC Reference***

The –10 volt output from the reference supply circuits, VR1/U14A, is used as the reference for the ALC loop. This voltage is summed with the ALC slope (voltage) from the A29 Rear Panel Interface PCB and with the output of the AM modulation circuits from the %AM DAC. This modified reference voltage goes to the 12-Bit Level DAC, U17.

The output of U17 is fed to the 8-Bit ALC Range DAC, U19A, which further expands the resolution of the control range of the ALC loop. The combination of the 12-bit Level DAC and the 8-bit Range DAC provides a 1 million-bit resolution over the typical 20 dB control range of the level loop. The synthesizer main microprocessor sets the output voltage level from the ALC DAC circuits to be equal to that of the desired RF output signal.

c. ***AM Circuit***

The external AM modulation signals from the front and rear panel input connectors are buffered by Input Amplifiers U6A and U6D. The outputs of these amplifiers are connected to the AM Peak Detector, AM Trough Detector, and the %AM DAC circuits.

The output of the %AM DAC is summed with the ALC reference voltage (and the ALC Slope voltage) before being applied to the ALC Level DACs. This maintains a constant-percentage AM signal with a changing reference-level voltage. The combined reference signal from the ALC Level DACs is routed to the ALC level amplifier as described above.

The output of the %AM DAC, U9B, is adjusted by the main microprocessor to provide the necessary AM signal voltage required for the %AM modulation desired. The desired %AM modulation level is selected either from the front panel or via the GPIB.

NOTE

> If the external AM modulation input signal is 1 volt peak, then the actual %AM modulation will equal the %AM level selected. If the input signal is not 1 volt peak, then the %AM will be something other than the %AM selected.

The *Peak* and *Trough* Detectors, U11A–U11D, provide dc output voltages proportional to the amplitude of the AM modulation signal. These dc signals are among the various ALC signals that are selected by the U15 Analog Mux (multiplexer) for measurement by the digital voltmeter that is located on the A17 Analog Instruction PCB.

The actual percentage of am modulation can be measured and displayed using the front panel AM MEASURE function. When this function is selected, the main microprocessor instructs the A17 digital voltmeter to measure the voltages from the ALC peak and trough detectors. It then calculates the actual %AM modulation using the peak and trough measurements.

d. ***ALC Slope***

This circuit corrects for an increasing or decreasing output power-vs-frequency characteristic of the microwave generation/modulation circuits that comprise the synthesizer. This correction is usually for a decreasing-output vs increasing-frequency characteristic (mainly caused by the level detectors and optional step attenuator). The V/GHz circuit located on the A29 Rear Panel Interface PCB supplies an ALC Slope correction that has a linear voltage change per linear change in frequency. This signal is routed to the ALC Slope circuits located on the A15 PCB.

The output from the unity gain buffer amplifier (U8) is fed to the Slope DAC (U9B), and to the ALC Reference circuits comprised of U8C/U8D and U16. Depending on the value programmed into the ALC Slope DAC, these circuits change the ALC slope voltage to be either zero, or an increasing or decreasing voltage relative to the output frequency.

The data for setting the ALC Slope DAC in the CW or stepped-sweep modes is located in the EEPROM (Electronically Erasable Programmable Read Only Memory). It is stored into the EEPROM by the main microprocessor during calibration of the synthesizer.

There are two additional settings for the ALC Slope DAC that are used only in the analog sweep mode. One is for ≤2 GHz (≤26.5 GHz on the 6742A). The other is for >2 GHz (>26.5 GHz on the 6742A).

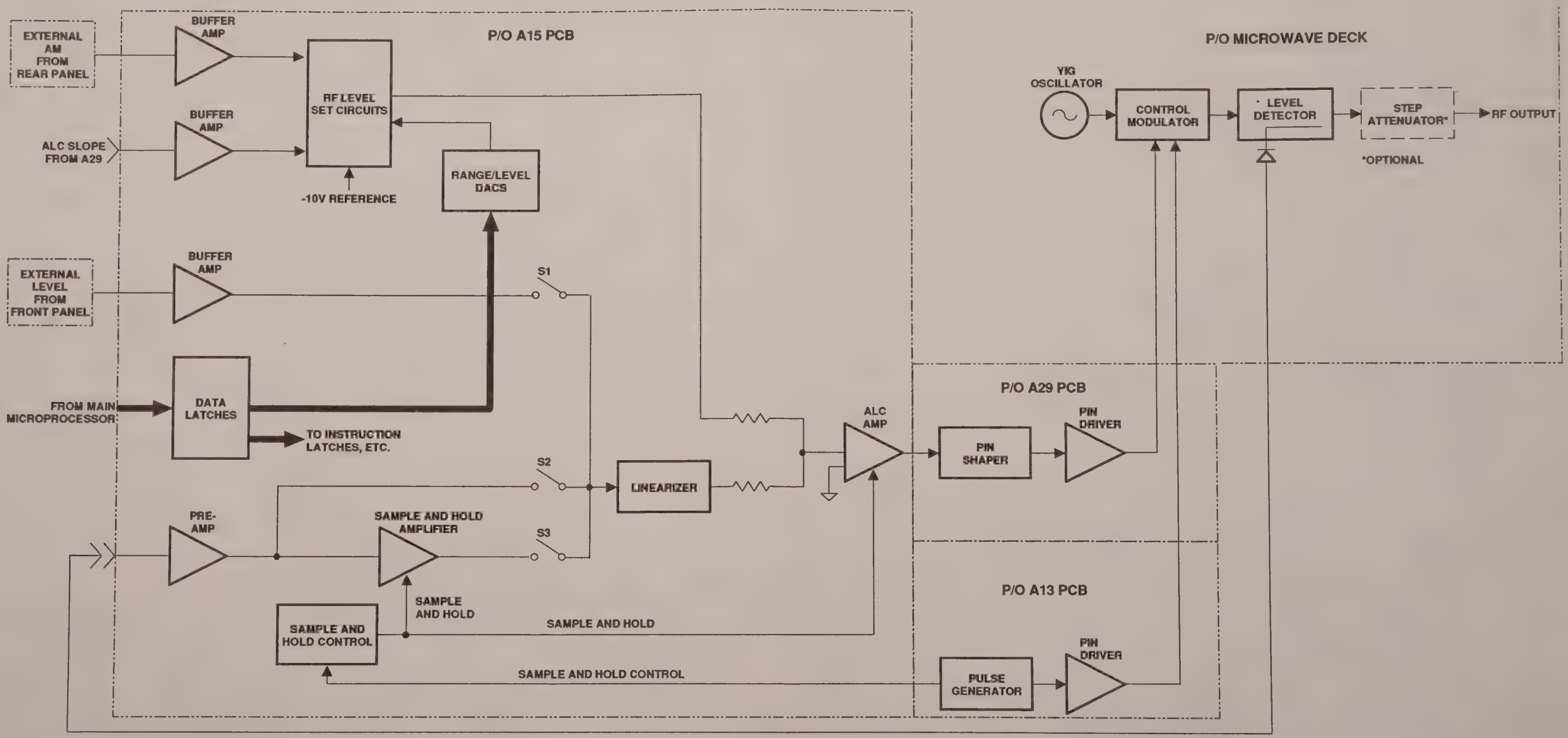

P/O A15 PCB
EXTERNAL AM FROM REAR PANEL
BUFFER AMP
ALC SLOPE FROM A29
BUFFER AMP
RF LEVEL SET CIRCUITS
-10V REFERENCE
RANGE/LEVEL DACS
EXTERNAL LEVEL FROM FRONT PANEL
BUFFER AMP
S1
FROM MAIN MICROPROCESSOR
DATA LATCHES
TO INSTRUCTION LATCHES, ETC.
S2
LINEARIZER
ALC AMP
PRE-AMP
SAMPLE AND HOLD AMPLIFIER
S3
SAMPLE AND HOLD
SAMPLE AND HOLD CONTROL
SAMPLE AND HOLD
SAMPLE AND HOLD CONTROL
P/O MICROWAVE DECK
YIG OSCILLATOR
CONTROL MODULATOR
LEVEL DETECTOR
STEP ATTENUATOR*
RF OUTPUT
*OPTIONAL
P/O A29 PCB
PIN SHAPER
PIN DRIVER
P/O A13 PCB
PULSE GENERATOR
PIN DRIVER

Figure 6M-1. Overall Block Diagram of the ALC Power Level Control Subsystem

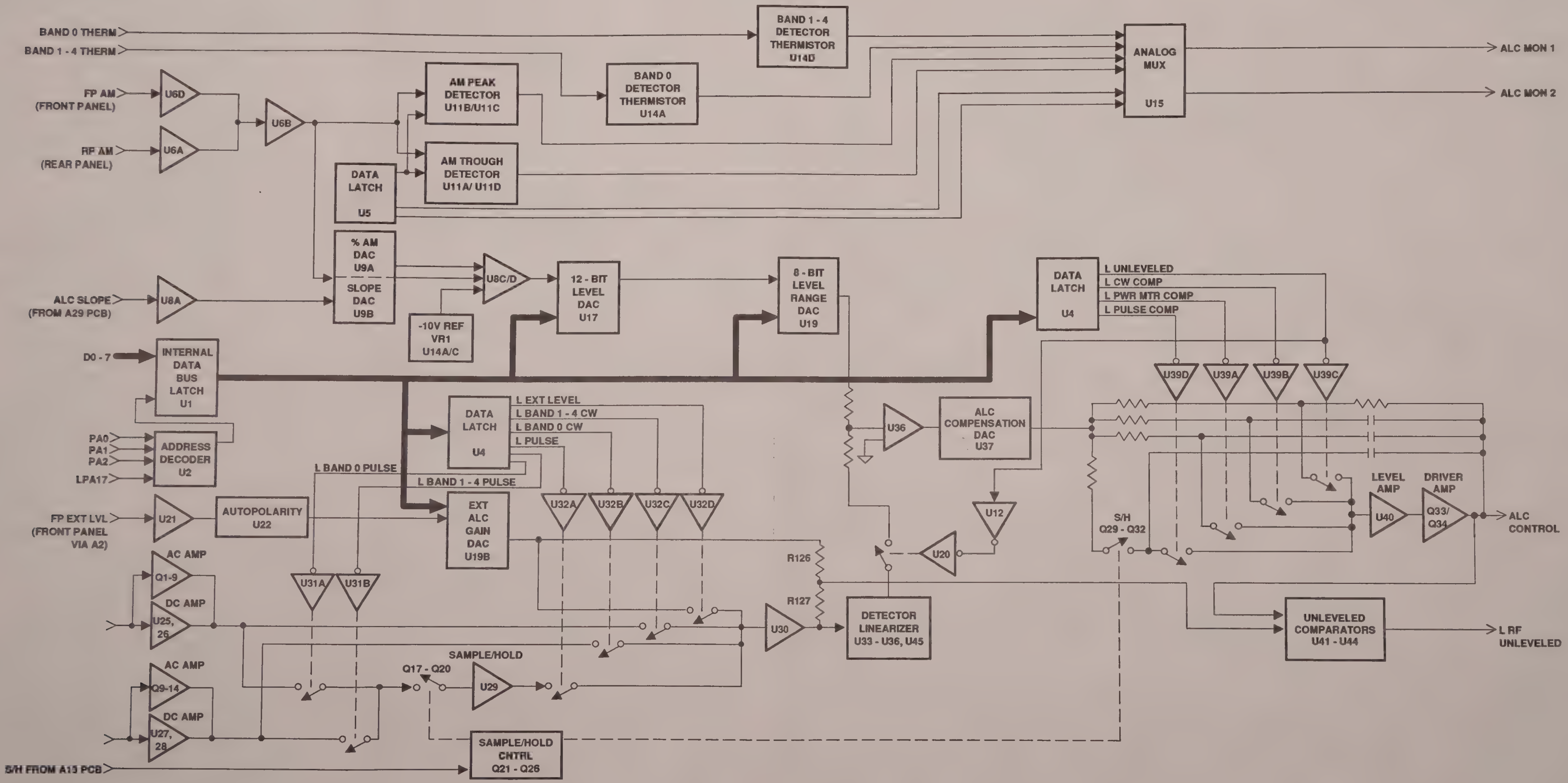

BAND 0 THERM
BAND 1 - 4 THERM
FP AM (FRONT PANEL)
RF AM (REAR PANEL)
U6D
U6A
U6B
AM PEAK DETECTOR U11B/U11C
AM TROUGH DETECTOR U11A/ U11D
BAND 0 DETECTOR THERMISTOR U14A
BAND 1 - 4 DETECTOR THERMISTOR U14D
ANALOG MUX U15
ALC MON 1
ALC MON 2
DATA LATCH U5
% AM DAC U9A
SLOPE DAC U9B
ALC SLOPE (FROM A29 PCB)
U8A
U8C/D
-10V REF VR1 U14A/C
12 - BIT LEVEL DAC U17
8 - BIT LEVEL RANGE DAC U19
DATA LATCH U4
L UNLEVELED
L CW COMP
L PWR MTR COMP
L PULSE COMP
D0 - 7
INTERNAL DATA BUS LATCH U1
PA0
PA1
PA2
LPA17
ADDRESS DECODER U2
DATA LATCH U4
L EXT LEVEL
L BAND 1 - 4 CW
L BAND 0 CW
L PULSE
L BAND 0 PULSE
L BAND 1 - 4 PULSE
U39D
U39A
U39B
U39C
U36
ALC COMPENSATION DAC U37
FP EXT LVL (FRONT PANEL VIA A2)
U21
AUTOPOLARITY U22
EXT ALC GAIN DAC U19B
U32A
U32B
U32C
U32D
U12
U20
S/H Q29 - Q32
LEVEL AMP
DRIVER AMP
U40
Q33/ Q34
ALC CONTROL
AC AMP
Q1-9
DC AMP
U25, 26
U31A
U31B
R126
R127
U30
DETECTOR LINEARIZER U33 - U36, U45
UNLEVELED COMPARATORS U41 - U44
L RF UNLEVELED
SAMPLE/HOLD
Q17 - Q20
U29
AC AMP
Q9-14
DC AMP
U27, 28
SAMPLE/HOLD CNTRL Q21 - Q26
S/H FROM A13 PCB

Figure 6M-2. Overall Block Diagram of the A15 ALC PCB

e. ***Detector Preamps***

There are two sets of detector preamplifier circuits, Band 0 Det and Band 1-4 Det:

- Band 0 Det preamplifier circuits— These circuits are comprised of transistors Q1–Q8 and op amps U25/U26. They amplify the level detector output of the frequency down converter that is used for Band 0, i.e., output frequencies ≤2 GHz.
- Band 1–4 Det preamplifier circuits— These circuits are comprised of transistors Q9–Q16 and op amps U27/U28. They amplify the output of the main Directional Coupler/Level Detector that is used for bands 1 thru 4, i.e., output frequencies >2 GHz. (also for band 5; refer to Section 6Q).

The detector preamplifier circuits amplify the low-level-detector voltage by a factor of five and transform the 2 kΩ output impedance of the detector diode to less than 50Ω. Each preamp is composed of a low- and high-frequency amplifier section. The high-frequency amplifier section has a very high gain at high frequencies to compensate for the diode output capacitance and the interconnecting cable capacitance.

The outputs of the detector preamplifiers go to analog switch, A15. This switch selects either one of the two preamp outputs, or the output from the External ALC Amplifier, or the output from the Preamplifier Sample/Hold Circuit as the input to the non-inverting X5 gain stage (U30). The output of U30 is routed to the input of the Detector Shaper circuits.

For operating in the pulse modulation mode, the appropriate preamp output signal is selected (U31A/U31B) and is routed through the Preamplifier Sample/Hold circuits (comprised of transistors Q17–Q20 and op amp U29). The output of U29 is then selected by switch A15. The operation of the preamplifier sample/hold circuit (in conjunction with ALC Level Amplifier sample/hold circuit) causes the ALC leveling loop to effectively sense only the *ON* portion of the pulsed RF output signal.

f. ***External Level Circuit***

In the external level mode of operation, an external detector is used to monitor the output of the 67XXA synthesizer; the output of this detector is connected to the front panel EXT LEVEL connector. The dc signal from the connector is routed via a X5 preamplifier located on the A2 Front Panel Control PCB to the input of the A15 Ext Detector Buffer Amplifier, U21.

Analog switch U20 in this circuit is controlled by the main microprocessor and is used to reduce the gain of U21 to less than one. This switch is closed whenever a power meter, or similar device having a relative high output, is used for external leveling. (A power meter usually has a typical output of 1 volt, which is much higher than that of a directional detector.) During the external ALC gain calibration procedure (described below) the gain calibration comparator circuits will sense this much-higher voltage, which will cause the microprocessor to close U20 to lower the circuit gain.

The output of U21 goes to the Autopolarity Detector, U22. This circuit automatically senses the polarity of the external level detector signal and switches it so that the signal polarity to the input of the Ext ALC Gain DAC (U19B) is always negative. The output of U19B goes to analog switch A15, as described above.

g. ***External Gain Cal***

The input voltage at the EXTERNAL LEVEL input connector can vary over a large range. A means of calibrating the external detector voltage to a level usable by the ALC loop is provided. This calibration procedure is invoked from the front panel and is performed by the synthesizer main microprocessor. When the Ext Gain Cal button is pressed, the following occurs:

1. The output of the appropriate internal detector (Band 1-4 or Band 0) is switched to the input of the Linearizer Buffer Amp (U30) and the RF output is leveled.
2. The Ext ALC Gain DAC is set to a low value (high attenuation).
3. The output of the Ext ALC Gain DAC is summed with the output of U30 via R126 and R127. The voltage at the junction of these two resistors goes to the gain-calibration comparator circuit, U41/U42, which are part of the Unleveled Compensation circuits.
4. If the input voltage from the EXTERNAL LEVEl input is too high, U41/U42 pulls the L UNLEVELED line low. (Which is sensed by the main microprocessor via the A29 Rear Panel Interface PCB.)

5. The microprocessor then closes switch U20 that reduces the gain of the Ext Detector Buffer Amplifier.
6. After closing the switch, it again steps the bits of the Ext ALC Gain DAC and monitors the L UNLEVELED line with each step.
7. When the microprocessor determines the correct DAC setting, it opens the (U15) switch connecting he internal detector voltage to U30 and closes the switch that connects the external level input voltage.
8. The RF power at the output of the external level detector will then be set equal to the power for which the 6700A is set in the INT leveling mode.

h. *Detector Shaper Circuits*

The percentage of amplitude modulation of a RF signal is the ratio of the modulating voltage vs the RF carrier *voltage*. The detector diodes that are part of the Level Detectors are square-law devices; that is, the output voltage of these devices is a function of the input *power*. To maintain a constant %AM with changing RF power levels and prevent the introduction of AM distortion, a linear voltage output versus RF *voltage* input response is necessary.

To compensate for the square-law characteristic of the detector signal, the Detector Shaper circuits translate the detector signal characteristic to one having a linear voltage output versus RF *voltage* input response. These circuits are comprised of transistors U45A–U45D and op amps U33–U36 and U46. The output of these circuits is switched to one input of the ALC Level Amplifier Comparator circuit (U36) via analog switch U20B.

i. *ALC Level Amplifier Comparator and ALC Gain DAC Circuits*

When the RF output of the 6700A is leveled, the ALC level reference voltage from the Level Range DAC and the output from the Detector Shaper circuits are of equal value but of opposite polarity. These voltages are summed by resistors R162 and R163. The difference voltage at the junction of these two resistors is the ALC loop error voltage.

The ALC loop error voltage is amplified by op amp U36 and goes to the input of the ALC Compensation DAC, U37. This DAC adjusts the overall loop gain and bandwidth of the ALC loop. The settings for this DAC are determined during calibration procedure for each frequency band. During normal operation, at each bandswitch point (of a multiband unit), the microprocessor sets the ALC Compensation DAC to the value saved in EEPROM during calibration.

j. *ALC Level Amplifier*

In the normal mode of operation, the output from the ALC compensation DAC buffer amplifier (U38) is switched directly to the input of the main ALC Level Amplifier, U40. During the pulse modulation mode of operation, this switch path is opened and the output of U38 is routed through the Sample/Hold circuits (described below). The output of the sample/hold circuits is then switched to the input of U40. The output of op amp U40 goes to the driver transistors Q33 and Q34. The output of these transistors is the ALC signal that is routed to the PIN diode current drivers located on the A29 Rear Panel Interface PCB.

The output of Q33 and Q34 is also feed back to the limiting and frequency compensation networks that are part of the input to U40. The frequency compensation network, in combination with the setting of the ALC Gain DAC, determines the overall ALC loop bandwidth. In a non-pulse mode, the loop bandwidth is typically 70 kHz. In the pulse mode, the bandwidth is approximately 20 kHz. (This bandwidth also depends on the pulse width and repetition frequency of the pulse modulation signal.) When externally leveled with a power meter, the loop bandwidth is approximately 0.6 Hz. This narrow bandwidth compensates for the slow response of a power meter.

k. *Sample/Hold Circuits*

The main ALC sample/hold circuit is comprised of transistors Q29–Q32 and holding capacitor C73. These circuits (and the Preamplifier Sample/Hold circuit) are only used during the pulse modulation mode of operation.

During the RF *ON* portion of the RF output pulse, holding capacitor C73 is charged through Q32 to the value of the ALC error signal output by U38. During the RF *OFF* condition of the pulse, Q32 is off and the voltage level stored by C73 is used as the input to U40. This action prevents the ALC loop from shifting the output level during the *OFF* portion of the pulse (which would cause distortion of the pulse waveform).

The drive signals for the main ALC sample/hold circuit and the Preamplifier Sample/Hold circuit are generated by the Sample/Hold Switch circuits comprised of transistors Q21–Q26. These circuits function as a chain of three flip-flops that produce the correct drive signals to step the signals from the detector inputs through the ALC circuits to the ALC Level Amplifier during the pulse modulation mode of operation.

The first flip-flop of the chain (Q21/Q22) is driven by the S/H EN signal from the A13 Pulse Generator PCB. This automatically synchronizes the A15 sample/hold circuits with the pulse drive to the pulse modulators.

l. ***Unleveled/ Ext ALC Cal Logic Circuit***

In normal operation, comparitors U43 and U44 sense the output of the ALC Level Amplifier. If the RF output does not reach the power level requested, or is too high, then the Level Amplifier goes outside of its normal 0V to +3V operating range. When this occurs, either U43 or U44 will pull the L UNLEVELED line low, which will:

- Turns on the front panel UNLEVELED indicator LED.
- Signal the main microprocessor (via the A29 PCB) that the ALC loop is no longer controlling the RF output level.

When an Ext Gain Cal operation is performed, the normal sensing of the ALC Level Amp comparitor is disabled, and the L UNLEVELED line is used as an indicator by the main microprocessor.

m. ***Detector Thermistor Circuits***

The internal Level Detector(s) each have a built-in thermistor that is used in conjunction with the A15 Thermistor Circuits to sense the ambient temperature of these components. (Only those units that are equipped with a frequency down converter have two level detectors.)

The A15 Thermistor Circuits are comprised of op amps U14B and U14D. These circuits translate the resistances of the level detector thermistors into voltage values that represent the temperature of the respective level detectors.

The voltage values output by these circuits are monitored by the A17 PCB DVM circuits via the Analog MUX, U15. As the ambient temperature changes, the microprocessor compensates for the changes in the level detector diode output levels with temperature. This provides a very stable RF-output-vs-temperature characteristic.

6M-1.3 A13 Pulse Generator PCB Circuit Description

The A13 PCB provides the internal pulse generating function for the synthesizer and interfaces the external pulse signal source to the pulse generation and PIN driver circuits in the external modes. The 67XXA has three pulse modulation modes:

- Internal pulse modulation mode– In this mode, the pulse modulation waveform is generated internally.
- External PULSE mode– In this mode, the external pulse source signal from the front or rear panel connectors is interfaced directly to the pulse modulation PIN driver circuits.
- External GATE mode– In this mode, the external pulse source gates the pulse generator on and off.

The internal pulse generation and external pulse source interface circuitry of the A13 PCB is contained in four major circuit groups:

- 10-Hz-to-1-MHz programmable pulse generator,
- Source/Mode select control circuits,
- Current driver circuits for the pulse modulation PIN diodes located in the control modulators.
- Microprocessor data interface circuits.

The paragraphs that follow describe these circuit groups. Refer to the A13 simplified block diagram , Figure 6M-3. Refer also to the A13 PCB schematic, Figure 6M-8, as necessary.

a. ***Pulse Generator***

The 10 MHz reference signal from the A10 Reference Divider PCB is routed to the A13 pulse generator clock divider circuits, which are comprised of U4,U5, and U6. The 10 MHz is divided down into clock signals PRF CLK and PW CLK that are used to trigger the Pulse Rep Frequency Counter and Pulse Width Counter circuits, respectively. The proper clock frequency for the desired pulse repetition frequency and pulse width is selected by the Pulse Clock Select multiplexer (U8/U15), under control of the synthesizer main microprocessor.

The Pulse Rep Frequency Counter (U11–U13) produces a Pulse Rep Freq clock signal (DIVIDED PRF CLK) that goes to the Pulse Source Select circuit. This integrated circuit switch (U24) gates the trigger signals to the pulse generation circuits according to the mode selected (under control of the synthesizer main microprocessor).

In the internal pulse generation mode of operation, the DIVIDED PRF CLK signal is routed via U24 to the Pulse Start FF, U27A. When clocked by the PRF CLK signal, U27A is set, which then sets the Pulse FF (U28A).

The output from the Pulse FF triggers the Pulse Width Counter (U17–U20) to start the count down of the pulse width. At the end of the count, the Pulse Stop FF (U27B) is set, which resets the Pulse FF and reloads the Pulse Width Counter in preparation for the next pulse.

At the end of the pulse repetition rate period, the output of the Pulse Rep Frequency Counter changes state. This action triggers the Pulse Start FF again and the process repeats.

NOTE

> The pulse width must always be programmed to be less than the period of the pulse repetition rate.

In the external GATE mode of operation, the DIVIDED PRF CLK signal to the Pulse Source Select circuit is gated on and off according to the external pulse source waveform by U2B and U14B. The Pulse Source Select circuit also connects the external pulse signal to the Gating Edge FF (U25A) of the pulse generator circuits.

The external pulse signal sets the Gating Edge FF, which then sets—and is immediately reset by—the Gate Edge Clear FF, U25B. This action sets the Pulse FF; the generation of the remainder of the pulse is as described above.

NOTE

> For proper operation, the period of the external pulse source signal must be greater than the sum of the pulse repetition rate period and pulse width of the internal pulse waveform. The pulse width of the external pulse source must also exceed that of the internal pulse.
>
> If the period of the external pulse source signal is greater than a multiple of the internal pulse period, the modulation waveform will contain multiple pulses. This technique may be used to obtain pulse-burst modulation of the RF output signal.

The output of the Pulse FF is routed via buffer gate U26A to the rear panel PULSE SYNC OUTPUT connector. This output is also routed to the input of the Pulse Resolution generator circuits.

The Pulse Resolution Generator circuits comprised of U28B, U29 and U30, function as a delay line with three outputs that are delayed by 25, 50, and 75 nanoseconds. The selection of these outputs, OR'ed together with the output of the Pulse FF, provide 25 ns pulse width resolution for all internally generated pulses from 25 ns to 100 us pulse width.

b. *Source/Mode Select Control Circuits*

In the internal mode of operation, the pulse source select circuit (U24) connects the DIVIDED PRF CLK signal through to the pulse generator circuits. Also, the mode select circuit (U31) connects the output of the Pulse FF to the input to the pulse PIN driver circuits (via the 100 & 25 ns Pulse Resolution circuits).

In the external GATE mode of operation, the external pulse source signal controls the Pulse Source Select circuit, thus controlling the operation of the pulse generator circuits (see above).

In the external PULSE mode of operation, the mode select circuit (U31) connects the external pulse source signal (from the front/rear panel input connectors) to the input of the pulse modulation PIN driver circuits. The RF output signal is thus modulated with the external source waveform.

The output of U31 is routed to the A15 ALC PCB as the L SAMPLE/HOLD signal. This signal synchronizes the ALC leveling loop to the pulse-*ON* portion of the pulse modulation waveform.

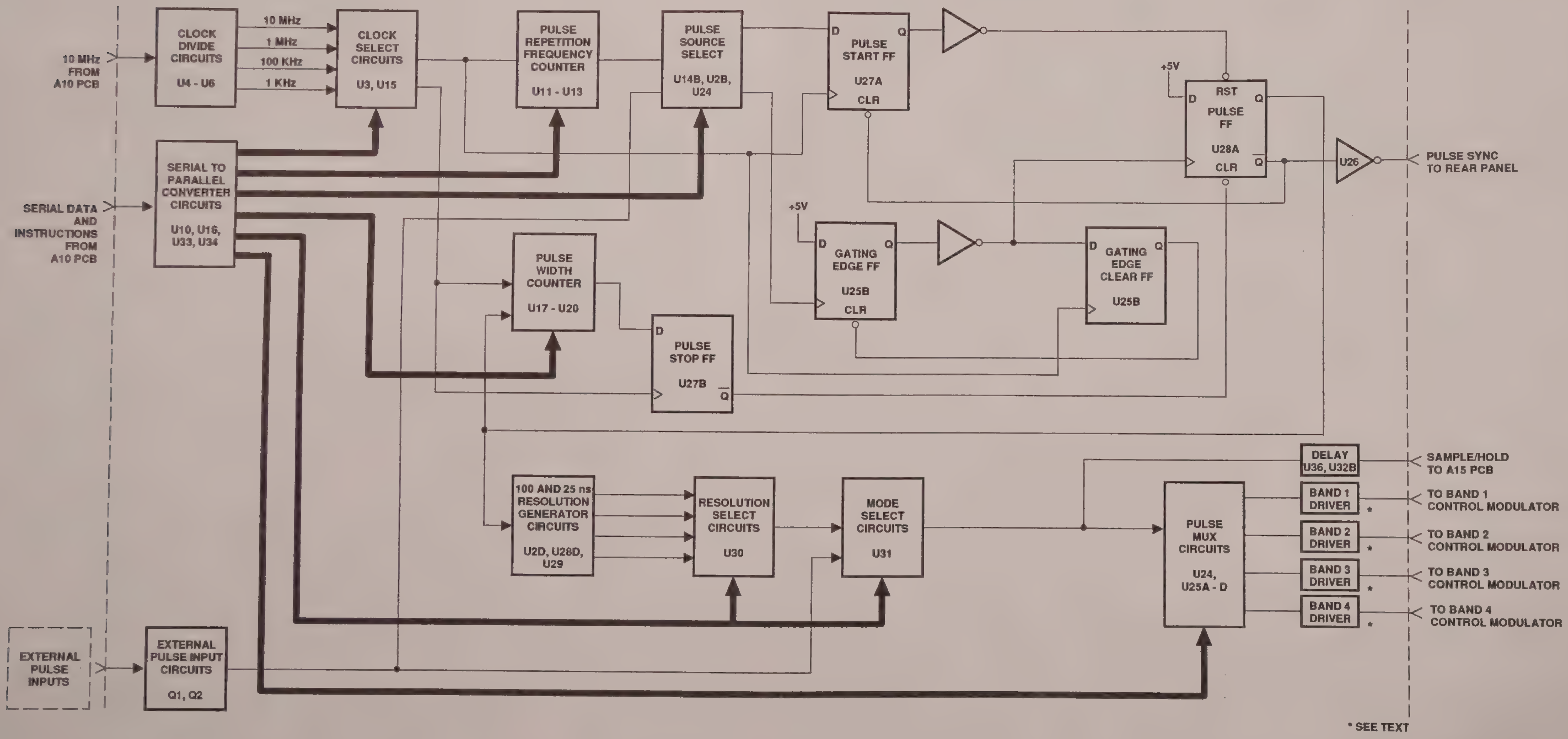

10 MHz FROM A10 PCB
CLOCK DIVIDE CIRCUITS
U4 - U6
10 MHz
1 MHz
100 KHz
1 KHz
CLOCK SELECT CIRCUITS
U3, U15
PULSE REPETITION FREQUENCY COUNTER
U11 - U13
PULSE SOURCE SELECT
U14B, U2B, U24
D
PULSE START FF
U27A
Q
CLR
+5V
D
RST
PULSE FF
U28A
Q
CLR
Q
U26
PULSE SYNC TO REAR PANEL
SERIAL DATA AND INSTRUCTIONS FROM A10 PCB
SERIAL TO PARALLEL CONVERTER CIRCUITS
U10, U16, U33, U34
+5V
D
GATING EDGE FF
U25B
Q
CLR
D
GATING EDGE CLEAR FF
U25B
Q
PULSE WIDTH COUNTER
U17 - U20
D
PULSE STOP FF
U27B
Q
DELAY U36, U32B
SAMPLE/HOLD TO A15 PCB
100 AND 25 ns RESOLUTION GENERATOR CIRCUITS
U2D, U28D, U29
RESOLUTION SELECT CIRCUITS
U30
MODE SELECT CIRCUITS
U31
PULSE MUX CIRCUITS
U24, U25A - D
BAND 1 DRIVER
*
TO BAND 1 CONTROL MODULATOR
BAND 2 DRIVER
*
TO BAND 2 CONTROL MODULATOR
BAND 3 DRIVER
*
TO BAND 3 CONTROL MODULATOR
BAND 4 DRIVER
*
TO BAND 4 CONTROL MODULATOR
EXTERNAL PULSE INPUTS
EXTERNAL PULSE INPUT CIRCUITS
Q1, Q2
* SEE TEXT

Figure 6M-3. Overall Block Diagram of the A13 Pulse Generator PCB

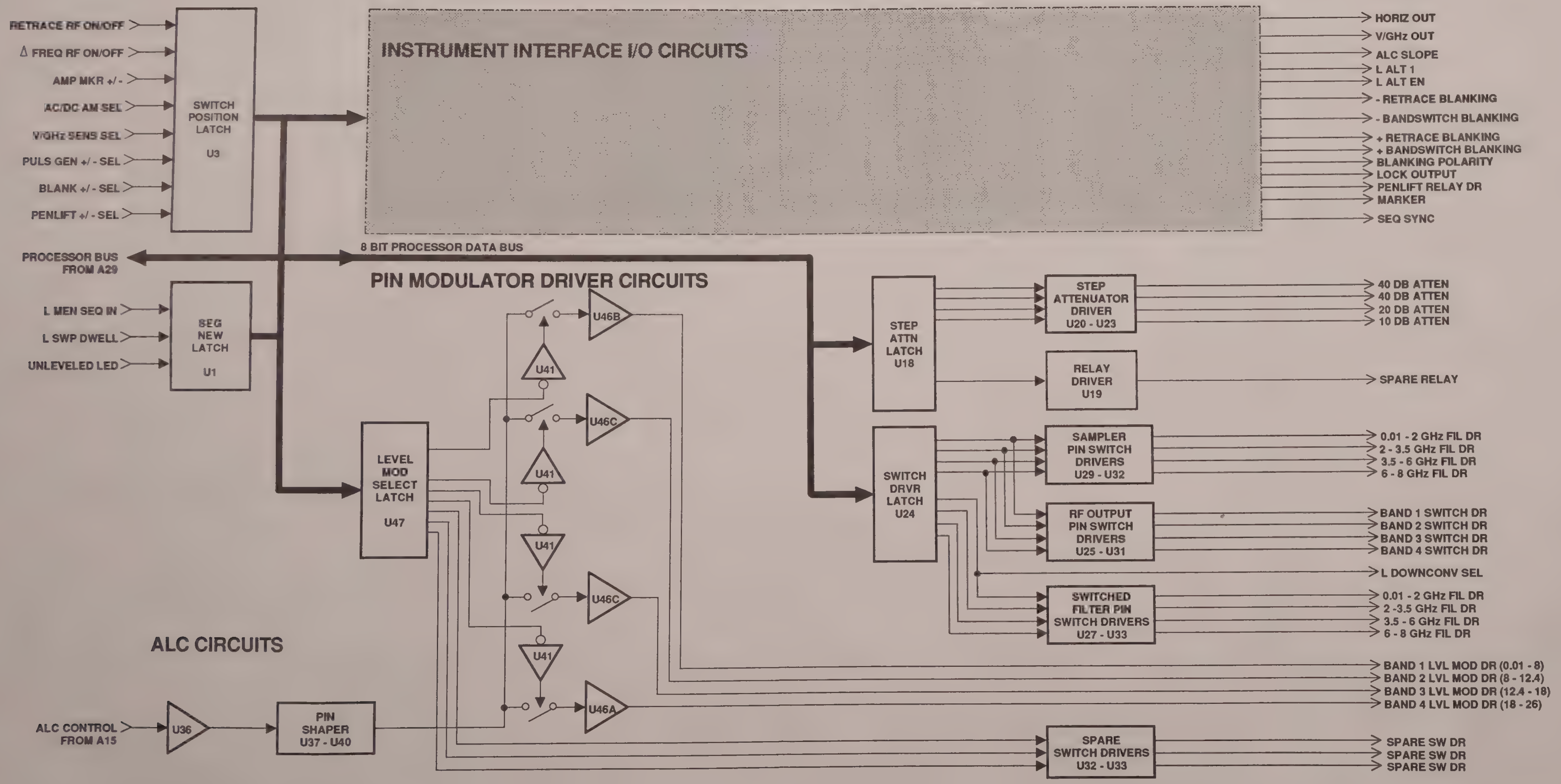

RETRACE RF ON/OFF
Δ FREQ RF ON/OFF
AMP MKR +/-
AC/DC AM SEL
V/GHz SENS SEL
PULS GEN +/- SEL
BLANK +/- SEL
PENLIFT +/- SEL
SWITCH POSITION LATCH
U3
INSTRUMENT INTERFACE I/O CIRCUITS
HORIZ OUT
V/GHz OUT
ALC SLOPE
L ALT 1
L ALT EN
- RETRACE BLANKING
- BANDSWITCH BLANKING
+ RETRACE BLANKING
+ BANDSWITCH BLANKING
BLANKING POLARITY
LOCK OUTPUT
PENLIFT RELAY DR
MARKER
SEQ SYNC
PROCESSOR BUS FROM A29
8 BIT PROCESSOR DATA BUS
PIN MODULATOR DRIVER CIRCUITS
L MEN SEQ IN
L SWP DWELL
UNLEVELED LED
SEG NEW LATCH
U1
U46B
U41
U46C
U41
LEVEL MOD SELECT LATCH
U47
U41
U46C
U41
U46A
ALC CIRCUITS
ALC CONTROL FROM A15
U36
PIN SHAPER U37 - U40
STEP ATTN LATCH U18
STEP ATTENUATOR DRIVER U20 - U23
40 DB ATTEN
40 DB ATTEN
20 DB ATTEN
10 DB ATTEN
RELAY DRIVER U19
SPARE RELAY
SWITCH DRVR LATCH U24
SAMPLER PIN SWITCH DRIVERS U29 - U32
0.01 - 2 GHz FIL DR
2 - 3.5 GHz FIL DR
3.5 - 6 GHz FIL DR
6 - 8 GHz FIL DR
RF OUTPUT PIN SWITCH DRIVERS U25 - U31
BAND 1 SWITCH DR
BAND 2 SWITCH DR
BAND 3 SWITCH DR
BAND 4 SWITCH DR
L DOWNCONV SEL
SWITCHED FILTER PIN SWITCH DRIVERS U27 - U33
0.01 - 2 GHz FIL DR
2 -3.5 GHz FIL DR
3.5 - 6 GHz FIL DR
6 - 8 GHz FIL DR
BAND 1 LVL MOD DR (0.01 - 8)
BAND 2 LVL MOD DR (8 - 12.4)
BAND 3 LVL MOD DR (12.4 - 18)
BAND 4 LVL MOD DR (18 - 26)
SPARE SWITCH DRIVERS U32 - U33
SPARE SW DR
SPARE SW DR
SPARE SW DR

Figure 6M-4. Block Diagram of ALC Loop Circuitry Located on A29 Rear Panel Interface PCB

The output of U31 is also the input to the Leading Edge Delay and Trailing Edge Delay circuits comprised of U3C, U32B , and Q25. The output of these circuits is routed to the A15 ALC PCB as the L SAMPLE/HOLD signal.

c. ***Pulse Modulation PIN Drivers***
The output of U31 is also goes to the Pulse Mux circuit comprised of gates U35A–U35D. These gates route the pulse modulation signal to the proper PIN driver circuit for the band selected. The PIN drivers are high-speed high-current driver circuits that control the pulse PIN diodes located in the control modulators. These circuits are comprised as listed below.

- Band 1: Q3–Q7, and U36A, B and F.
- Band 2: Q8–Q12, and U36C, D and E.
- Band 3: Q13–Q17, and U37A, B and F.
- Band 4: Q18–Q22, and U37C, D and E.

d. ***Processor Interface Circuits***
The synthesizer main microprocessor controls the pulse generator to produce pulse modulation of the RF output signal per the commands received from either the front panel or via the GPIB. It talks to the A13 pulse generator through the A8 Serial I/O PCB. On the A15 PCB, serial-parallel interface circuits, U10/U16 and U33/U34, convert the serial data received from the A8 Serial I/O PCB into parallel data that is stored in control latches.

The serial data is clocked into the A13 PCB by two clocks from the A8 PCB: the Pulse Generator Clock, and the Pulse Trigger Clock. The instructions and data for the pulse generator circuits are clocked into U10 andU16 via the Pulse Generator Clock; this data is used to set the pulse frequency and pulse width. The instructions/data that is clocked into U33 and U34 by the Pulse Trigger Clock is used to select the operating mode and to select the appropriate pulse modulation PIN driver circuit.

6M-1.4 A29 Rear Panel Interface PCB Circuit Description

The following circuit description applies only to the portion of the A29 board that is part of the ALC power level control subsystem. Refer to the block diagram for these A29 circuits, Figure 6M-4 (facing page). The schematic diagrams for the complete A29 PCB are located in Section 6F–Inputs/Outputs.

a. ***ALC Control Signal Drive Circuits***
The ALC CNTL signal from the A15 PCB goes to the input of U36, a unity gain differential receiver. From U36 it goes to the PIN shaping circuit comprised of U37–U40. This circuit shapes the ALC drive signal and boosts its power level. This increase in loop gain improves the bandwidth during AM operation.

The output of U39 goes to Analog Switch U41. This switch multiplexes the signal to the four PIN modulator drivers. Level Modulator Select Latch U47 controls U41 to route the ALC drive signal to the appropriate PIN modulator.

There are four identical PIN modulator driver circuits. These circuits drive the level control PIN diodes located in the Control Modulators located on the microwave deck. Refer to the schematic diagram located in Section 6F–Inputs/Outputs for further details:

- Band 1: U42 and U46B .
- Band 2: U43, and U46C.
- Band 3: U44 and U46D.
- Band 4: U45 and U46A.

b. ***PIN Switch Drivers***
There are 15 identical PIN switch driver circuits located on the A29 PCB (Figure 6M-4). These circuits are used as follows:

• Sampler PIN MUX Switch,	(4)
• RF Output PIN (main) MUX Switch	(4)
• Switched Filter (optional)	(4)
• Spares	(3)

Refer to the schematic diagram located in Section 6F–Inputs/Outputs for further details.

c. ***Step Attenuator Control***
There are four drivers for the step attenuator. These circuits are controlled by the main microprocessor and each will drive either a four-section attenuator or a three-section attenuator. In the case of a three-section attenuator, one of the drivers is not used. The various step attenuators used are:

- Three-section Attenuator with 10, 20, and 30 dB sections (70 dB),
- Four-section Attenuator with 10, 20, 30, and 30 dB sections (90 dB),
- Four-section Attenuator with 10, 20, 40, and 40 dB sections (110dB),

- Four-section Attenuator with 10, 20, 20, and 20 dB sections (70 dB).

Relay driver U19 is a spare driver circuit provided for future use. This circuit is almost identical to the step attenuator driver circuit.

6M-1.5 ALC Loop Microwave Deck Components

The following paragraphs briefly describe the microwave components that are part of—or interface with—the ALC loop. For further information about these components, refer to Section 6Q–Microwave Deck.

a. Control Modulator
The control modulator provides the variable attenuator for control of the RF power from the YIG oscillator. Part of the RF input is coupled out before modulation to a sampled RF output. This sampled RF goes to the multiplexing switch for the phase-lock circuitry. For further information, refer to Section 6Q–Microwave Deck.

b. Switched Filter
The switched filter is installed in models containing a 2–8 GHz oscillator. It provides rejection of the harmonics generated by the 2–8 GHz oscillator and multiplexing of the 0.01–2 GHz RF from the down converter. For further information, refer to Section 6Q–Microwave Deck.

c. Main Mux Switch
The Main Mux switch multiplexes the various control modulator outputs into a common output port. This switch is not installed in units having only one oscillator. For further information, refer to Section 6Q–Microwave Deck.

d. Sampler Mux Switch
The Sampler Mux switch multiplexes the sampled RF output from each of the control modulators to a common port. The selected RF signal goes to the sampler of the YIG phase-lock loop. The Sampler Mux switch is not used in single-band units having only one oscillator. For further information, refer to Section 6Q–Microwave Deck.

6M-2 ALC / PULSE MODULATION SUBSYSTEM SCHEMATICS

Figures 6M-5 thru 6M-8 provide schematics and parts locator diagrams for the A13 and A15 PCBs. Figure 6M-4 is the block diagram of the A29 PCB circuits that are part of—or interface with—the ALC loop; schematic diagrams for the complete A29 PCB are located in Section 6F–Inputs/Outputs.

6M-3 RF POWER AND CONTROL SUBSYSTEM TROUBLESHOOTING

Table 6M-2 contains a list of the error codes that pertain to the ALC power level control subsystem circuitry located on the A15 PCB, A13 PCB, part of the A29 PCB. This table also includes simple troubleshooting hints for these PCBs. The troubleshooting information for the microwave components located on the microwave deck are contained in Section 6Q–Microwave Deck.

Refer also to Section 6C–Troubleshooting, which provides general troubleshooting information for this and other subsystems.

Table 6M-2. ALC / Pulse Modulation Troubleshooting (1 of 2)

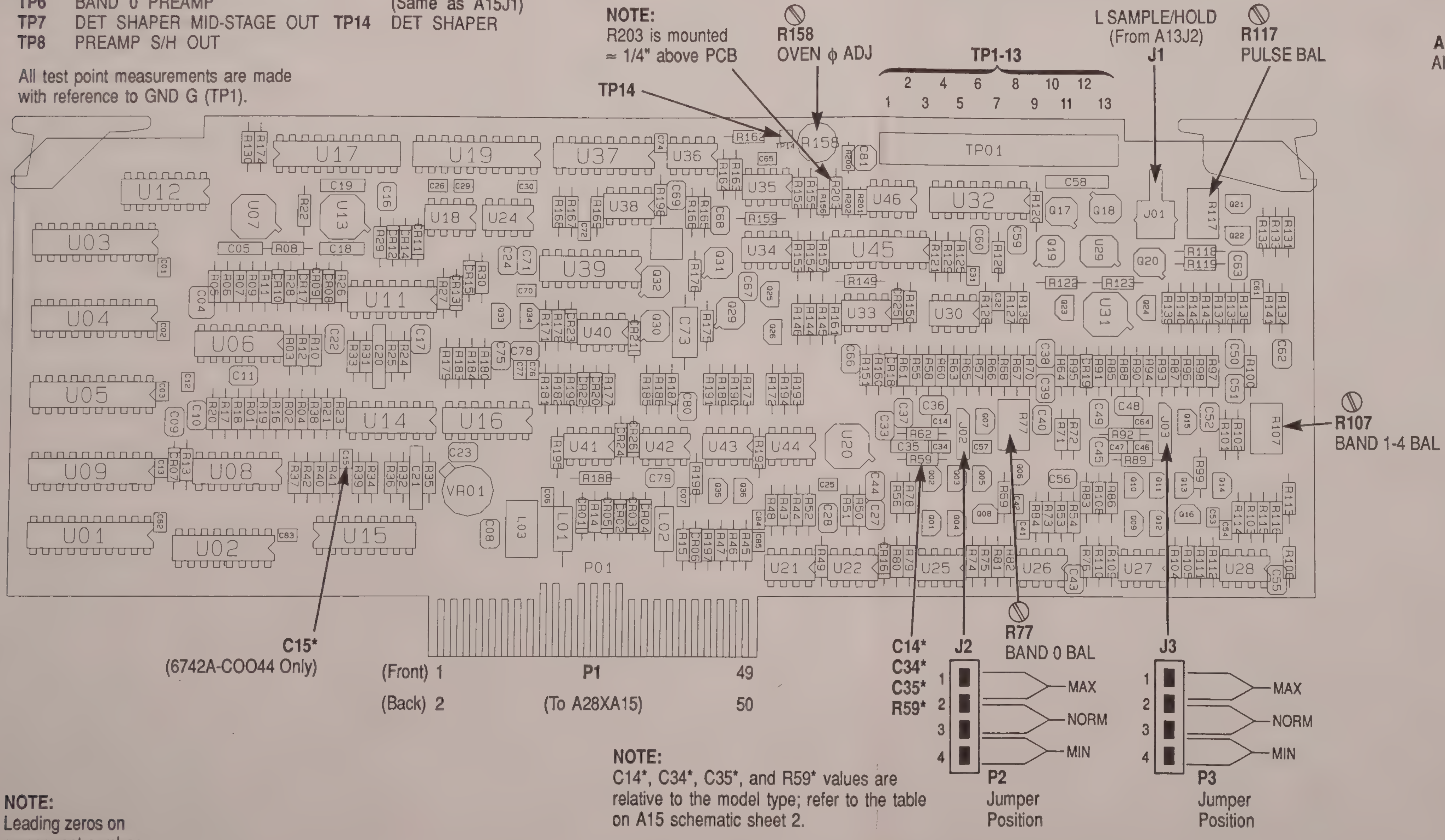
Table 6M-2. ALC / Pulse Modulation Troubleshooting (2 of 2)

Error Code	Description	Remarks/Possible Problem Area
	A13 Pulse Generator PCB	
E13-10	Pulse Generator Error	One or more Pulse Generator circuits are defective. Swap out A13 PCB.
	A15 ALC PCB	
E15-10	UNLEVELED-Indicator-On Error — The front panel UNLEVELED indicator is always on.	Check A15U42-44.
E15-11	UNLEVELED-Indicator-Off Error — The front panel UNLEVELED indicator will not come on.	Check A15U12, U40, U42-44.
E15-13	Phase Error, AM Peak Detector — The AM Peak Detector is inoperative.	Check A15U11, U13, U15.
E15-14	Phase Error,AM Trough Detector — Failure indicates that the AM Trough Detector is inoperative.	Check A15U11, U13, U15.
E15-15	–10V Ref Error	The A15 PCB –10V reference supply is inoperative: Check A15VR1 and A15U14.
E15-16	+10V Ref Error	The A15 PCB +10V reference supply is inoperative: Check A15VR1 and A15U14.
E15-20	Unleveled Error, Full Band — The RF output is unleveled (maximum output) across the entire frequency range. (If only one band is unleveled, one of the E18- thru E21-series error codes should be shown.)	
E15-21	No RF Error, Full Band — No RF output is present across the entire frequency range. (If only one band is unleveled, one of the E18- thru E21-series error codes should be shown.)	
E15-22	Slope DAC Error	Slope DAC is inoperative: Check A15U8, A15U9.
E15-23	Detector Path Error, Band 0 CW	Either the Downconverter or the Band 0 Detector Preamplifier on the A15 PCB is defective.
E15-24	Detector Path Error, Band 1-4 CW	Either the Band 1-4 Level Detector or Band 1-4 Preamplifier on the A15 PCB is defective.
E15-25	Detector Path Error, Band 0 Sample/Hold — This test is bypassed if the E15-23 test passes.	This detector path, which is used during pulse operations, is defective.
E15-26	Detector Path Error, Band 1-4 Sample/Hold — This test is bypassed if the E15-24 test passes.	This detector path, which is used during pulse operations, is defective.
E15-30	Band 0 Pulse Error — This test is bypassed if the E13-10 test passes.	Indicates that the A13 PCB pulse driver for Band 1, Band 1 Control Modulator, or A15 Sample/Hold circuit is defective.
E15-31	Band 1-4 Pulse Error — This test is bypassed if the E13-10 test passes.	The A13 PCB pulse drivers, or the A15 PCB Sample/Hold circuit is defective.
E15-40	Voltage Level reference error.	

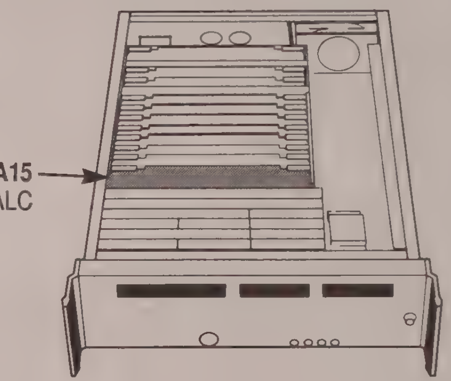
TEST POINTS

TP1	GND G	TP9	(ALC) SLOPE B
TP2	BUFFERED AM INPUT	TP10	LEVEL AMP OUT
TP3	ALC REF	TP11	Not Used
TP4	EXT LVL	TP12	Not Used
TP5	BAND 1-4 PREAMP	TP13	L SAMPLE/HOLD (Same as A15J1)
TP6	BAND 0 PREAMP		
TP7	DET SHAPER MID-STAGE OUT	TP14	DET SHAPER
TP8	PREAMP S/H OUT		

All test point measurements are made with reference to GND G (TP1).

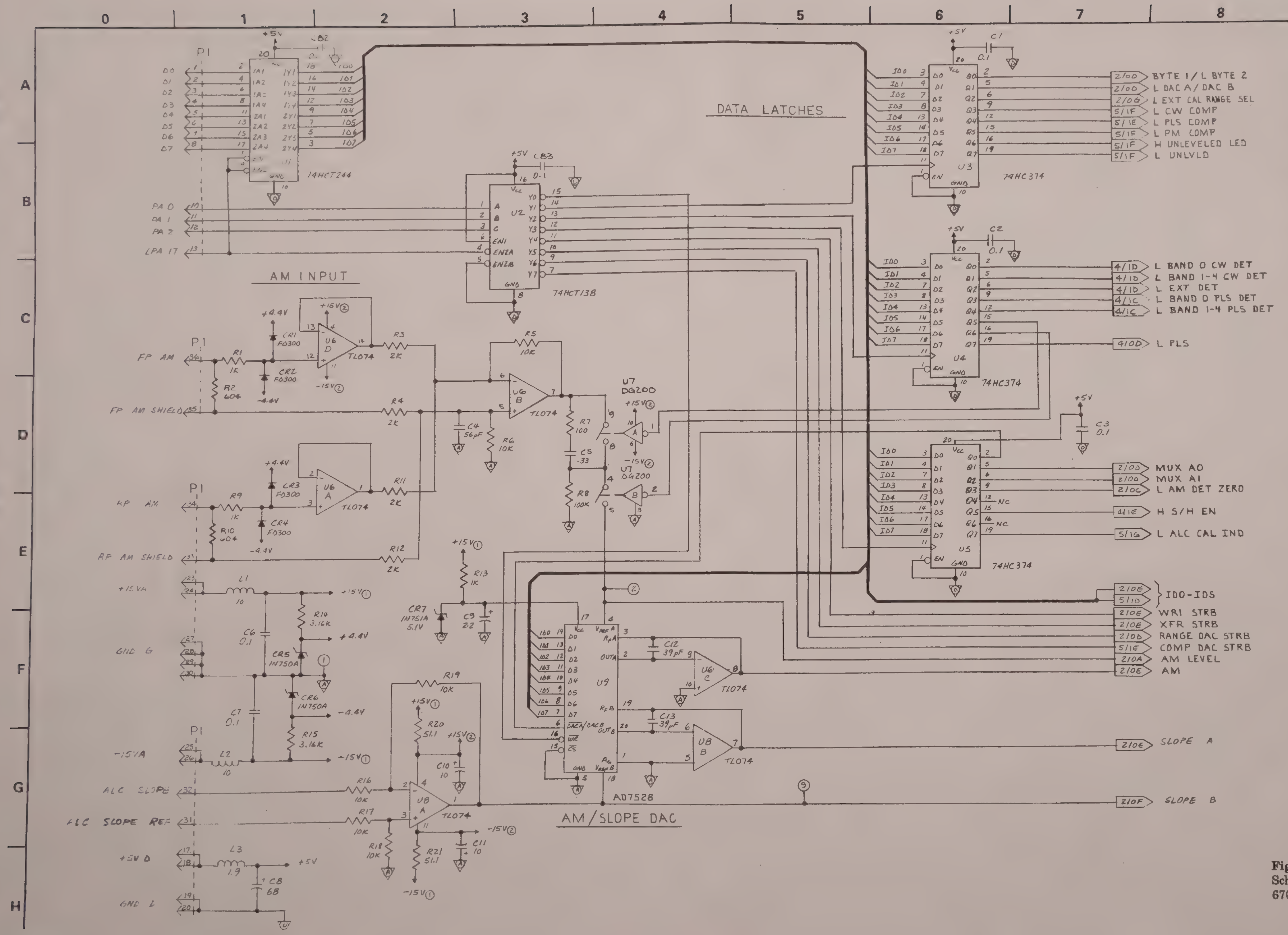

NOTE:
R203 is mounted
≈ 1/4" above PCB
TP14
R158
OVEN ϕ ADJ
TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
L SAMPLE/HOLD
(From A13J2)
J1
R117
PULSE BAL
R107
BAND 1-4 BAL
TP01
U17
U19
U37
U36
U12
U07
U13
U18
U24
U38
U35
U46
U32
U03
U39
U34
U45
U04
U11
U40
U33
U30
U31
U06
U05
U14
U16
U41
U42
U43
U44
U20
U09
U08
VR01
U01
U02
U15
L03
L01
L02
U21
U22
U25
U26
U27
U28
P01
J01
J02
J03
R77
C15*
(6742A-C0044 Only)
(Front) 1
P1
49
(Back) 2
(To A28XA15)
50
C14*
C34*
C35*
R59*
J2
R77
BAND 0 BAL
J3
1
2
3
4
MAX
NORM
MIN
P2
Jumper
Position
P3
Jumper
Position

NOTE:
C14*, C34*, C35*, and R59* values are relative to the model type; refer to the table on A15 schematic sheet 2.



NOTE:
Leading zeros on component number references may be disregarded.

Figure 6M-5. A15 ALC PCB Parts Locator Diagram 6700-D-31715-3 (Rev. K)


0
1
2
3
4
5
6
7
8
A
B
C
D
E
F
G
H
P1
D0
D1
D2
D3
D4
D5
D6
D7
14HCT244
PA 0
PA 1
PA 2
LPA 17
U2
74HCT138
DATA LATCHES
ID0
ID1
ID2
ID3
ID4
ID5
ID6
ID7
U3
74HC374
U4
74HC374
U5
74HC374
2/0D BYTE 1/L BYTE 2
2/0D L DAC A/DAC B
2/0G L EXT CAL RANGE SEL
5/1F L CW COMP
5/1E L PLS COMP
5/1F L PM COMP
5/1F H UNLEVELED LED
5/1F L UNLVLD
4/1D L BAND 0 CW DET
4/1D L BAND 1-4 CW DET
4/1D L EXT DET
4/1C L BAND 0 PLS DET
4/1C L BAND 1-4 PLS DET
4/0D L PLS
2/0D MUX A0
2/0D MUX A1
2/0C L AM DET ZERO
4/1E H S/H EN
5/1G L ALC CAL IND
2/0E 5/1D ID0-ID5
2/0E WR1 STRB
2/0E XFR STRB
2/0D RANGE DAC STRB
5/1E COMP DAC STRB
2/0A AM LEVEL
2/0E AM
2/0E SLOPE A
2/0F SLOPE B
AM INPUT
FP AM
FP AM SHIELD
RP AM
RP AM SHIELD
U6 D TL074
U6 B TL074
U6 A TL074
U6 C TL074
U7 DG200
CR1 FD300
CR2 FD300
CR3 FD300
CR4 FD300
+15VA
GND G
-15VA
ALC SLOPE
ALC SLOPE REF
+5V D
GND L
CR5 1N750A
CR6 1N750A
CR7 1N751A 5.1V
U8 A TL074
U8 B TL074
U9
AD7528
AM/SLOPE DAC
+5V
+15V
-15V
+4.4V
-4.4V

A15 ALC SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   ISOLATED GROUND: A C D
4. ADJUSTABLE COMPONENTS ARE DENOTED WITH AN ASTERISK:

   R77 R107 R115 R158
5. FACTORY-SELECTED COMPONENTS ARE DENOTED WITH AN ASTERISK

   C14*, C15*, C34*, C35*, R59*
6. TEST POINTS ARE DENOTED AS:
7. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
8. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   R127, R128, U6-U8, U11, U13-U15, U17, U18, U20-U22, U24, U26, U28, U29, U32-U39, U41-U44, U46, VR1
9. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C85	Q27
CR26	Q28
J3	R124
L3	R148
P3	U10
Q36	U23
R203	U30
TP14	
U46	
VR1	
W2	

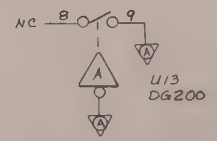

NC
8
9
A
U13
DG200

Figure 6M-6. A15 ALC PCB Schematic Diagram (Sheet 1 of 5) 6700-D-31715-3 (Rev. K)

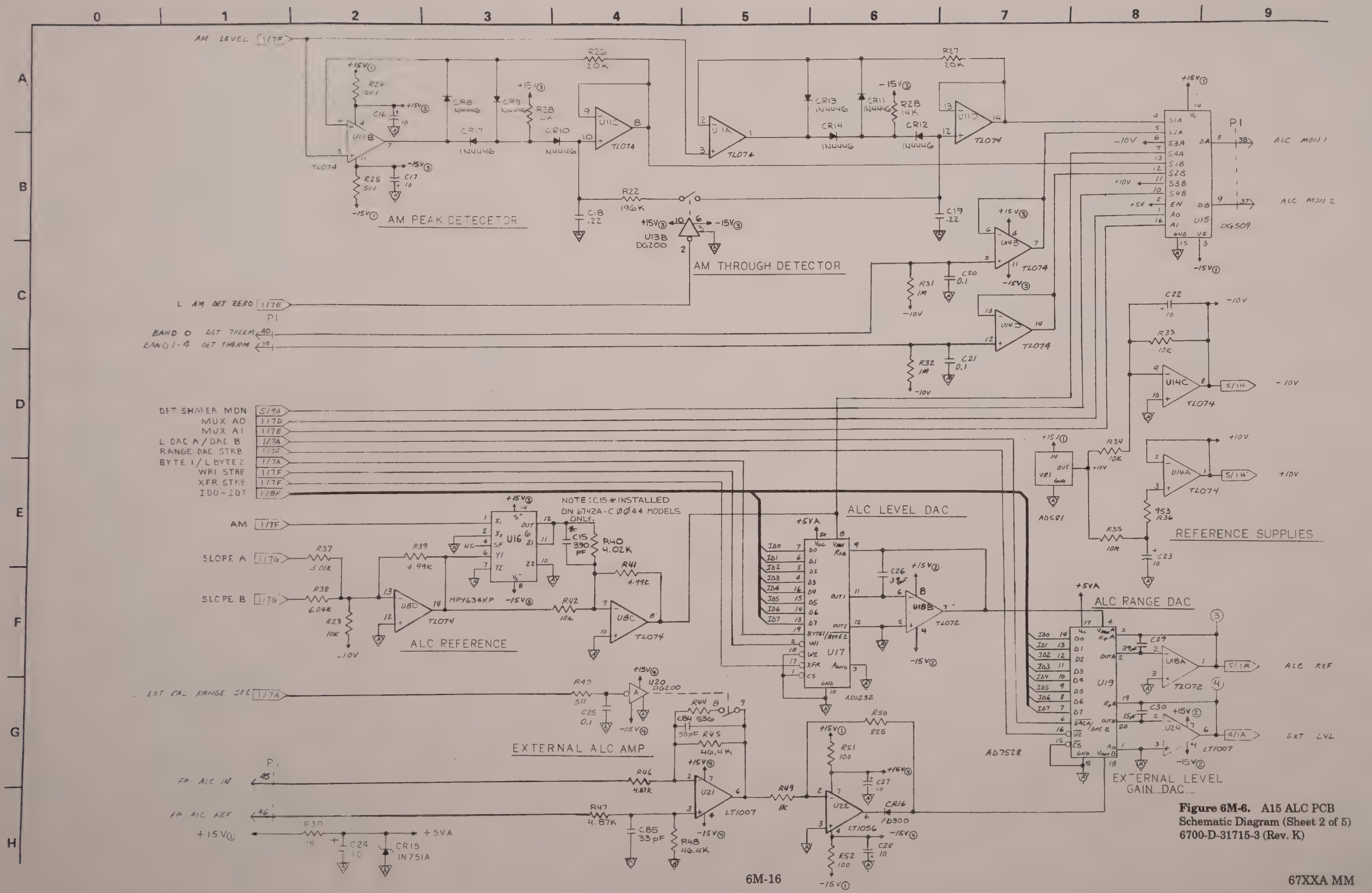
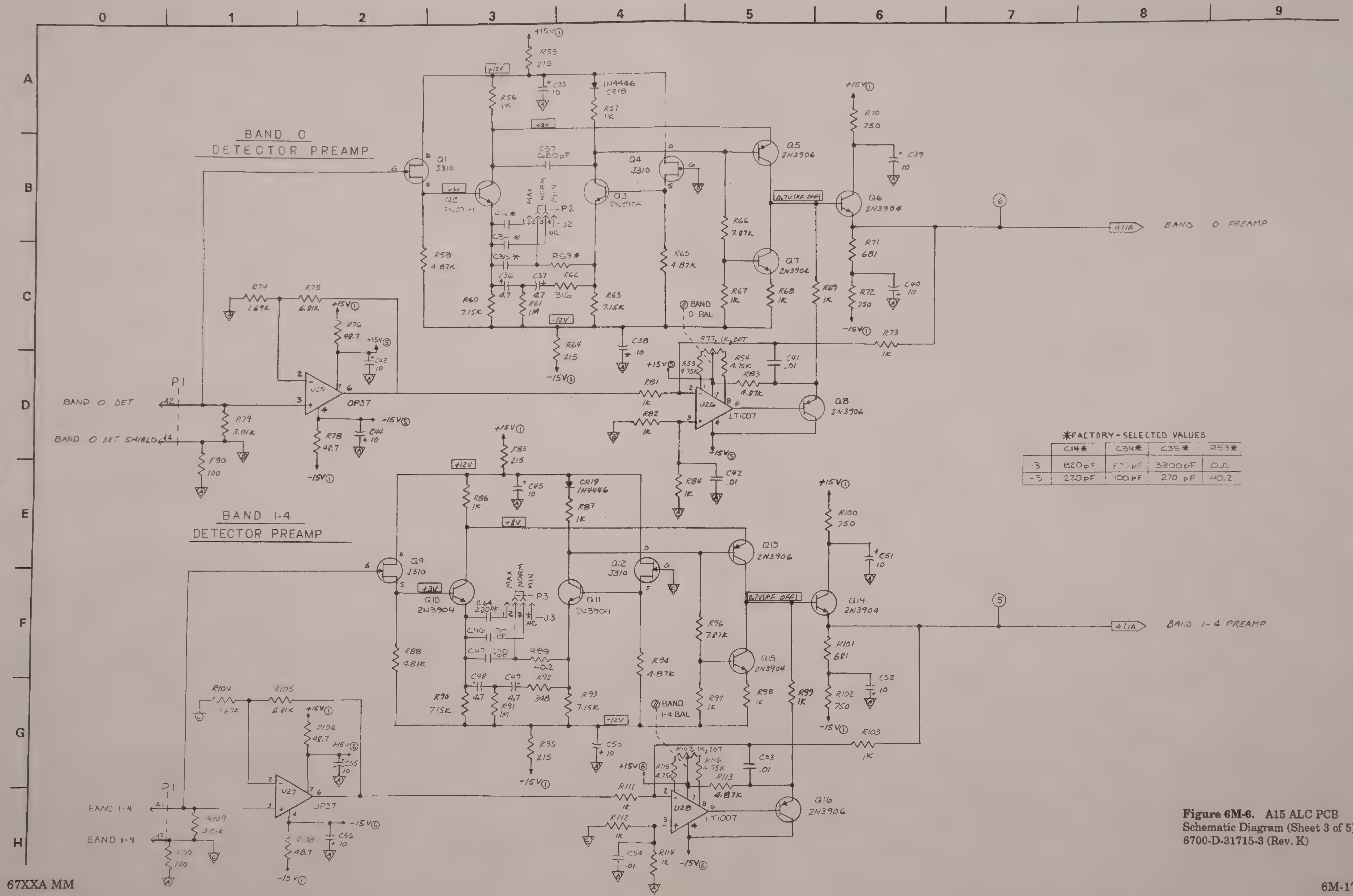

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
AM LEVEL 1/17E
+15V①
R24 511
C16 10
+15V③
CR8 1N4446
CR9 1N4446
+15V③
R28 1K
R26 20K
U11B
TL074
CR17 1N4446
CR10 1N4446
U11C
TL074
R25 511
C17 10
-15V③
-15V①
AM PEAK DETECTOR
C18 .22
R22 196K
+15V③
-15V③
U13B DG200
AM THROUGH DETECTOR
U11A
TL074
CR13 1N4446
CR14 1N4446
CR11 1N4446
-15V③
R28 14K
CR12 1N4446
R27 20K
U11D
TL074
C19 .22
+15V③
U14B
TL074
-15V③
R31 1M
-10V
C20 0.1
U14D
TL074
R32 1M
-10V
C21 0.1
+15V①
S1A
S2A
S3A
S4A
S1B
S2B
S3B
S4B
EN
A0
A1
GND
DA
DB
U15
DG509
-10V
+10V
+5V
-15V①
P1
ALC MON 1
ALC MON 2
L AM DET ZERO 1/17E
P1
BAND 0 DET THERM 40
BAND 1-4 DET THERM 39
C22 10
-10V
R33 10K
U14C
TL074
5/1H
-10V
DET SHAPER MON 5/19A
MUX A0 1/17D
MUX A1 1/17E
L DAC A/DAC B 1/7A
RANGE DAC STRB 1/17F
BYTE 1/L BYTE 2 1/7A
WR1 STRB 1/17F
XFR STRB 1/17F
ID0-ID7 1/18F
+15V①
IN
VR1
OUT
GND
AD581
R34 10K
+10V
U14A
TL074
5/1H
+10V
953 R36
R35 10K
C23 10
REFERENCE SUPPLIES
NOTE: C15* INSTALLED ON 6742A-C0044 MODELS ONLY.
AM 1/17F
SLOPE A 1/17G
SLOPE B 1/17G
R37 3.01K
R38 6.04K
R23 10K
-10V
R39 4.99K
U8D
TL074
ALC REFERENCE
+15V③
U16
MPY634KP
-15V③
C15 390 pF
R40 4.02K
R41 4.99K
R42 10K
U8C
TL074
ALC LEVEL DAC
+5VA
U17
AD7232
C26 39pF
+15V②
U18B
TL072
-15V②
+5VA
ALC RANGE DAC
U19
AD7528
C29 39pF
U18A
TL072
5/1A
ALC REF
C30 15pF
+15V②
U24
LT1007
-15V②
4/1A
EXT LVL
EXTERNAL LEVEL GAIN DAC
EXT CAL RANGE SEL 1/7A
R43 511
C25 0.1
+15V④
U20 DG200
-15V④
R44 536
C84 33pF
R45 46.4K
EXTERNAL ALC AMP
P1
FP ALC IN 45
FP ALC REF 46
R46 4.87K
R47 4.87K
+15V④
U21
LT1007
-15V④
C85 33pF
R48 46.4K
R49 1K
+15V①
R51 100
R50 825
C27 10
+15V④
U22
LT1056
CR16 FD300
-15V④
R52 100
C28 10
-15V①
+15V①
R30 1K
+5VA
C24 10
CR15 1N751A

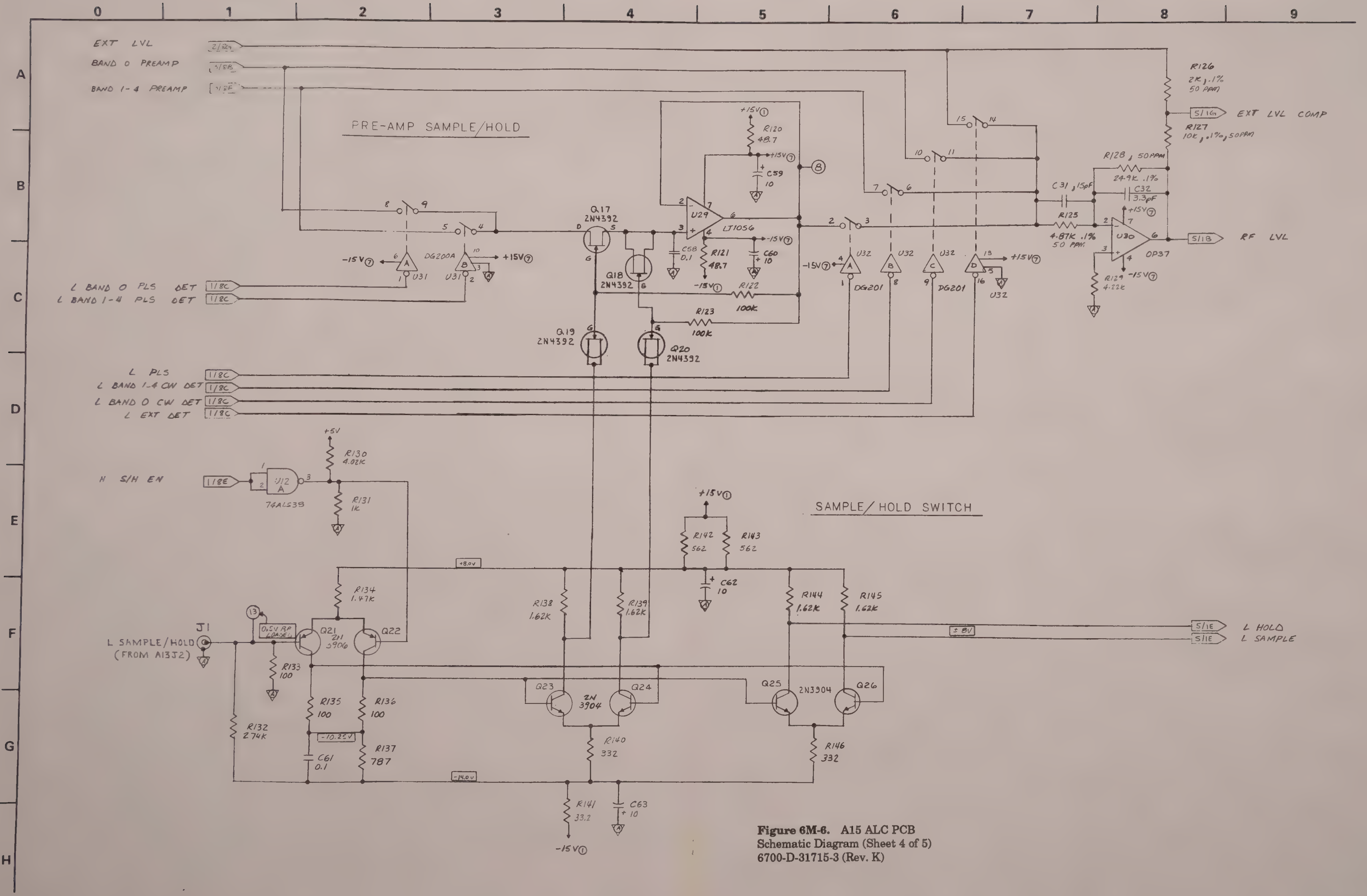
Figure 6M-6. A15 ALC PCB Schematic Diagram (Sheet 2 of 5) 6700-D-31715-3 (Rev. K)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
+15V①
R55
215
+12V
C33
10
IN4446
CR18
R56
1K
R57
1K
+8V
BAND 0
DETECTOR PREAMP
Q1
J310
G
D
S
C57
680pF
Q4
J310
Q5
2N3906
+15V①
R70
750
C39
10
+3V
Q2
2N3904
MAX
NORM
MIN
P2
J2
NC
C14 *
C34 *
Q3
2N3904
0.7V(RF OFF)
Q6
2N3904
⑥
4I1A
BAND 0 PREAMP
R66
7.87K
R71
681
R58
4.87K
C35 *
R59 *
R65
4.87K
Q7
2N3904
C36
4.7
C37
4.7
R62
316
C40
10
R74
1.69K
R75
6.81K
+15V①
R60
7.15K
R61
1M
R63
7.15K
BAND 0 BAL
R67
1K
R68
1K
R69
1K
R72
750
-12V
-15V①
R73
1K
R76
48.7
+15V⑤
C43
10
R64
215
-15V①
C38
10
R77, 1K, 20T
R53
4.75K
R54
4.75K
R83
4.87K
C41
.01
+15V⑤
P1
U25
OP37
R81
1K
U26
LT1007
Q8
2N3906
BAND 0 DET
42
44
BAND 0 DET SHIELD
R79
3.01K
R78
48.7
C44
10
-15V⑤
R82
1K
-15V⑤
R80
100
-15V①
+15V①
R85
215
+12V
C45
10
CR19
IN4446
R84
1K
C42
.01
R86
1K
R87
1K
+15V①
R100
750
+8V
BAND 1-4
DETECTOR PREAMP
Q13
2N3906
C51
10
Q9
J310
Q12
J310
+3V
Q10
2N3904
MAX
NORM
MIN
P3
J3
NC
C64
220PF
Q11
2N3904
0.7V(RF OFF)
Q14
2N3904
⑤
4I1A
BAND 1-4 PREAMP
C46
220PF
R96
7.87K
R88
4.87K
C47
220PF
R89
40.2
R94
4.87K
Q15
2N3904
R101
681
C48
4.7
C49
4.7
R92
348
C52
10
R104
1.69K
R105
6.81K
R90
7.15K
R91
1M
R93
7.15K
BAND 1-4 BAL
R97
1K
R98
1K
R99
1K
R102
750
+15V①
-12V
-15V①
R103
1K
R106
48.7
+15V⑥
C55
10
R95
215
-15V①
C50
10
R107, 1K, 20T
R115
4.75K
R116
4.75K
R113
4.87K
C53
.01
+15V⑥
P1
U27
OP37
R111
1K
U28
LT1007
Q16
2N3906
BAND 1-4
41
43
BAND 1-4
R109
3.01K
R108
48.7
C56
10
-15V⑥
R112
1K
R110
100
-15V①
C54
.01
R114
1K
-15V⑥

*FACTORY-SELECTED VALUES

	C14*	C34*	C35*	R59*
-3	820pF	[illegible] pF	3300pF	0Ω
-5	220pF	100pF	270 pF	40.2

Figure 6M-6. A15 ALC PCB Schematic Diagram (Sheet 3 of 5) 6700-D-31715-3 (Rev. K)



EXT LVL
BAND 0 PREAMP
BAND 1-4 PREAMP
PRE-AMP SAMPLE/HOLD
L BAND 0 PLS DET
L BAND 1-4 PLS DET
L PLS
L BAND 1-4 CW DET
L BAND 0 CW DET
L EXT DET
H S/H EN
U12 A 74ALS38
R130 4.02K
R131 1K
+5V
DG200A
U31
Q17 2N4392
Q18 2N4392
Q19 2N4392
Q20 2N4392
U29 LT1056
R120 48.7
R121 48.7
R122 100K
R123 100K
C58 0.1
C59 10
C60 10
+15V
-15V
U32
DG201
C31 15pF
C32 3.3pF
R125 4.87K .1% 50 PPM
R126 2K, .1% 50 PPM
R127 10K, .1%, 50PPM
R128, 50PPM 24.9K .1%
R129 4.22K
U30 OP37
EXT LVL COMP
RF LVL
SAMPLE/HOLD SWITCH
J1
L SAMPLE/HOLD (FROM A13J2)
0.5V RP LOADED
Q21
Q22
2N 3906
Q23
Q24
2N 3904
Q25
Q26
2N3904
R132 274K
R133 100
R134 1.47K
R135 100
R136 100
R137 787
R138 1.62K
R139 1.62K
R140 332
R141 33.2
R142 562
R143 562
R144 1.62K
R145 1.62K
R146 332
C61 0.1
C62 10
C63 10
+8.0V
-10.25V
-14.0V
±8V
L HOLD
L SAMPLE

Figure 6M-6. A15 ALC PCB
Schematic Diagram (Sheet 4 of 5)
6700-D-31715-3 (Rev. K)

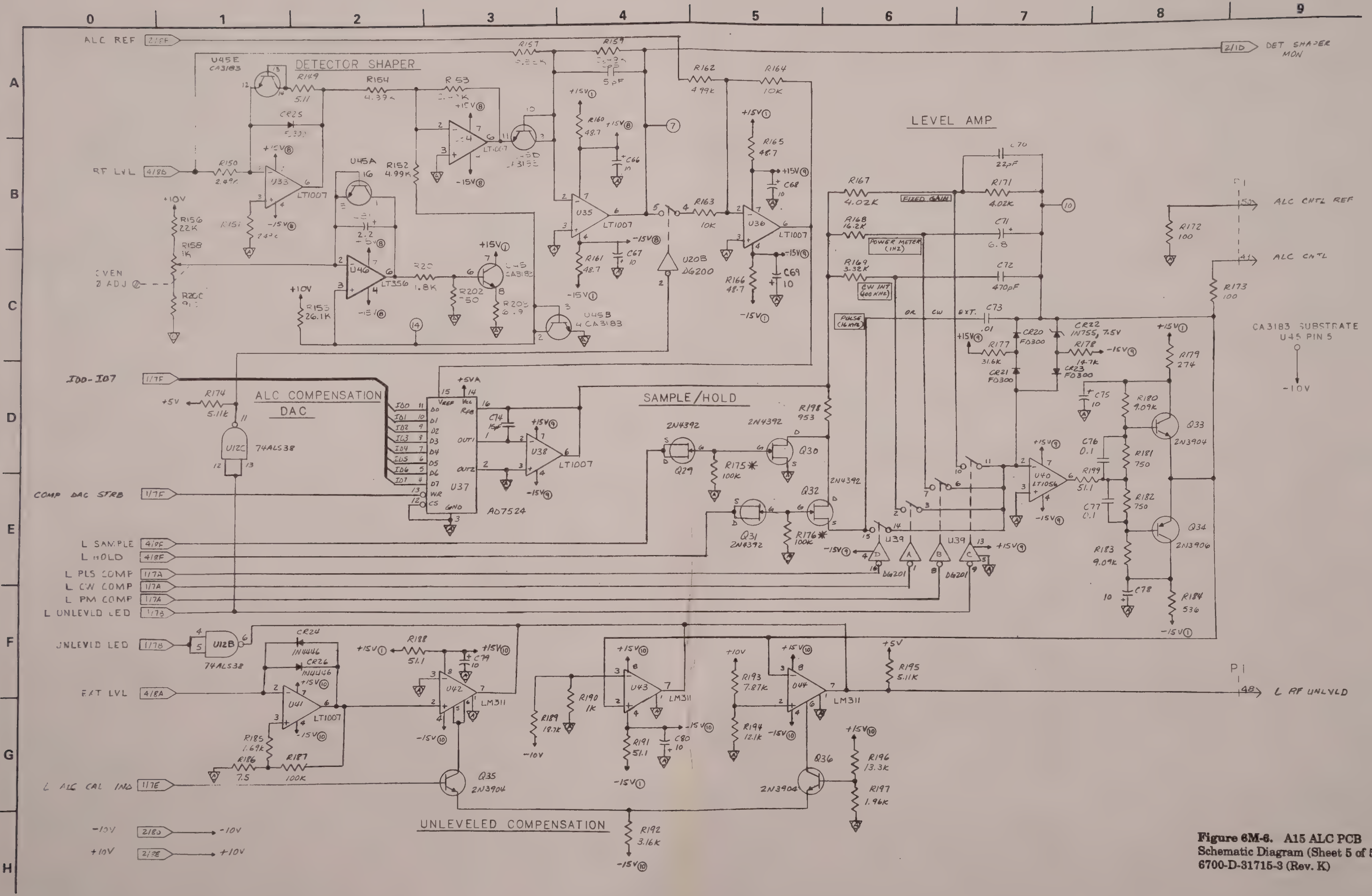
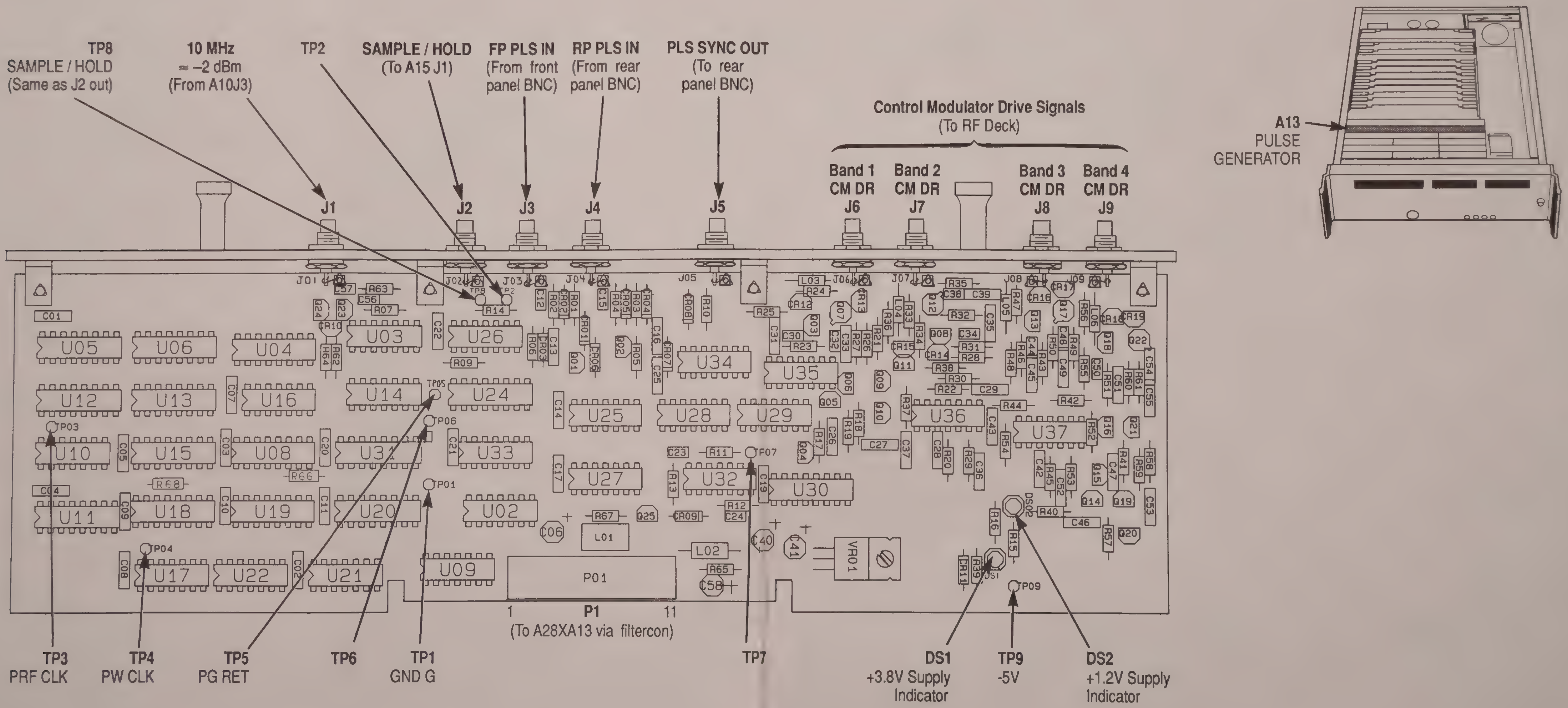
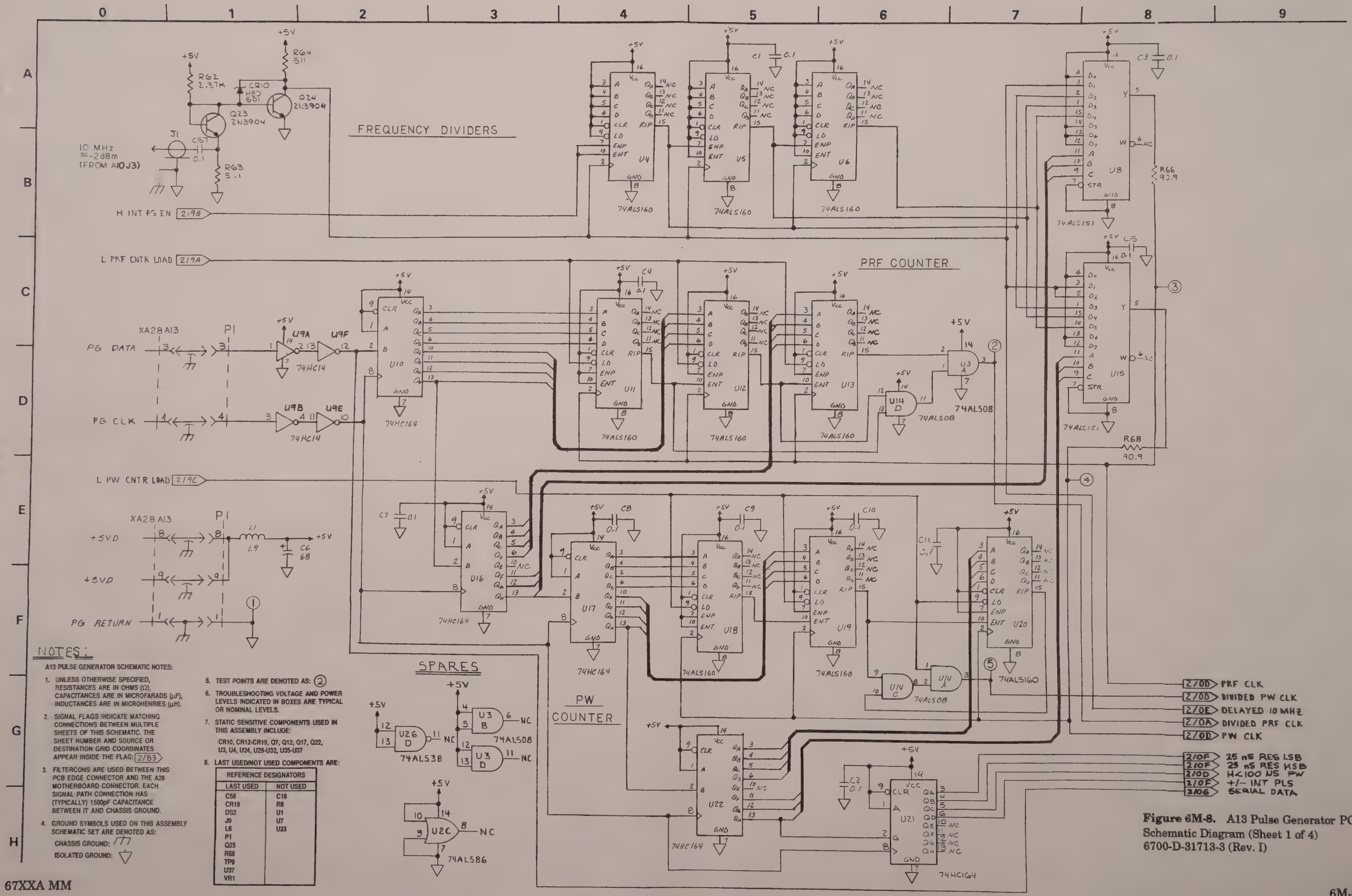

ALC REF
DET SHAPER MON
DETECTOR SHAPER
U45E CA3183
R149 5.11
R154 4.39k
R153
CR25
U33 LT1007
U34 LT1007
U45D CA3183
R157
R159
5pF
R160 48.7
C66 10
U35 LT1007
R161 48.7
C67 10
R162 4.99k
R164 10K
R163 10K
R165 48.7
C68 10
U36 LT1007
R166 48.7
C69 10
U20B DG200
RF LVL
R150 2.49k
R151
U45A
R152 4.99K
R156 22K
R158 1K
R200
OVEN Z ADJ
U46 LT356
R201 1.8K
U45C CA3183
R202 750
R203
R155 26.1K
U45B CA3183
LEVEL AMP
C70 22pF
R167 4.02K
FIXED GAIN
R171 4.02K
R168 16.2K
POWER METER (1HZ)
C71 6.8
R169 3.32K
CW INT (400 KHZ)
C72 470pF
PULSE (16 KHZ)
OR CW EXT.
C73 .01
R177 31.6K
CR20 FD300
CR21 FD300
CR22 1N755, 7.5V
R178 14.7K
CR23 FD300
R172 100
ALC CNTL REF
ALC CNTL
R173 100
P1
CA3183 SUBSTRATE U45 PIN 5
-10V
ID0-ID7
ALC COMPENSATION DAC
R174 5.11k
+5V
U12C 74ALS38
U37 AD7524
C74 15pF
U38 LT1007
COMP DAC STRB
SAMPLE/HOLD
2N4392
Q29
Q30
R175 100K
Q31 2N4392
Q32
R176 100K
R198 953
U39 DG201
U40 LT1056
C75 10
C76 0.1
C77 0.1
R199 51.1
R179 274
R180 9.09K
Q33 2N3904
R181 750
R182 750
Q34 2N3906
R183 9.09K
C78 10
R184 536
L SAMPLE
L HOLD
L PLS COMP
L CW COMP
L PM COMP
L UNLEVLD LED
UNLEVLD LED
U12B 74ALS38
CR24 1N4446
CR26 1N4446
EXT LVL
U41 LT1007
R185 1.69K
R186 7.5
R187 100K
R188 51.1
C79 10
U42 LM311
Q35 2N3904
L ALC CAL IND
R189 18.7K
R190 1K
U43 LM311
R191 51.1
C80 10
R192 3.16K
R193 7.87K
R194 12.1K
U44 LM311
Q36 2N3904
R195 5.11K
R196 13.3K
R197 1.96K
L RF UNLVLD
UNLEVELED COMPENSATION
-10V
+10V

Figure 6M-6. A15 ALC PCB Schematic Diagram (Sheet 5 of 5) 6700-D-31715-3 (Rev. K)


TP8
SAMPLE / HOLD
(Same as J2 out)
10 MHz
≈ −2 dBm
(From A10J3)
TP2
SAMPLE / HOLD
(To A15 J1)
FP PLS IN
(From front panel BNC)
RP PLS IN
(From rear panel BNC)
PLS SYNC OUT
(To rear panel BNC)
Control Modulator Drive Signals
(To RF Deck)
Band 1 CM DR J6
Band 2 CM DR J7
Band 3 CM DR J8
Band 4 CM DR J9
J1
J2
J3
J4
J5
A13
PULSE
GENERATOR
U05
U06
U04
U03
U26
U34
U35
U12
U13
U16
U14
U24
U25
U28
U29
U36
U37
U10
U15
U08
U31
U33
U32
U30
U27
U11
U18
U19
U20
U02
U17
U22
U21
U09
P01
VR01
L01
L02
1
P1
11
(To A28XA13 via filtercon)
TP3
PRF CLK
TP4
PW CLK
TP5
PG RET
TP6
TP1
GND G
TP7
DS1
+3.8V Supply
Indicator
TP9
-5V
DS2
+1.2V Supply
Indicator

NOTE:
Leading zeros on component number references may be disregarded.

Figure 6M-7. A13 Pulse Generator PCB Parts Locator Diagram
6700-D-31713-3 (Rev. I)


FREQUENCY DIVIDERS
PRF COUNTER
PW COUNTER
SPARES
10 MHz
≈-2dBm
(FROM A10J3)
J1
H INT PG EN 2/9G
L PRF CNTR LOAD 2/9A
L PW CNTR LOAD 2/9C
XA28 A13
P1
PG DATA
PG CLK
+5VD
PG RETURN
R62 2.37K
R64 511
R63 5.1
CR10 MBD 601
Q23 2N3904
Q24 2N3904
C57 0.1
L1 1.9
C6 68
U4 74ALS160
U5 74ALS160
U6 74ALS160
U8 74ALS151
U15 74ALS151
R66 90.9
R68 90.9
U9A U9F 74HC14
U9B U9E 74HC14
U10 74HC164
U11 74ALS160
U12 74ALS160
U13 74ALS160
U3 A 74ALS08
U14 D 74ALS08
U16 74HC164
U17 74HC164
U18 74ALS160
U19 74ALS160
U20 74ALS160
U14 A
U14 C 74ALS08
U22 74HC164
U21 74HC164
U26 D 74ALS38
U3 B 74ALS08
U3 D
U2C 74ALS86
2/0D PRF CLK
2/0D DIVIDED PW CLK
2/0E DELAYED 10 MHZ
2/0A DIVIDED PRF CLK
2/0D PW CLK
2/0F 25 nS RES LSB
2/0F 25 nS RES MSB
2/0D H<100 NS PW
2/0F +/- INT PLS
2/06 SERIAL DATA
0 1 2 3 4 5 6 7 8 9
A B C D E F G H

NOTES:

A13 PULSE GENERATOR SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. FILTERCONS ARE USED BETWEEN THIS PCB EDGE CONNECTOR AND THE A28 MOTHERBOARD CONNECTOR. EACH SIGNAL PATH CONNECTION HAS (TYPICALLY) 1500pF CAPACITANCE BETWEEN IT AND CHASSIS GROUND.
4. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND: /ᅲ
   ISOLATED GROUND: ▽
5. TEST POINTS ARE DENOTED AS: ②
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR10, CR12-CR19, Q7, Q12, Q17, Q22, U3, U4, U24, U29-U32, U35-U37
8. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C58	C18
CR19	R8
DS2	U1
J9	U7
L6	U23
P1	
Q25	
R68	
TP9	
U37	
VR1	

Figure 6M-8. A13 Pulse Generator PCB Schematic Diagram (Sheet 1 of 4) 6700-D-31713-3 (Rev. I)

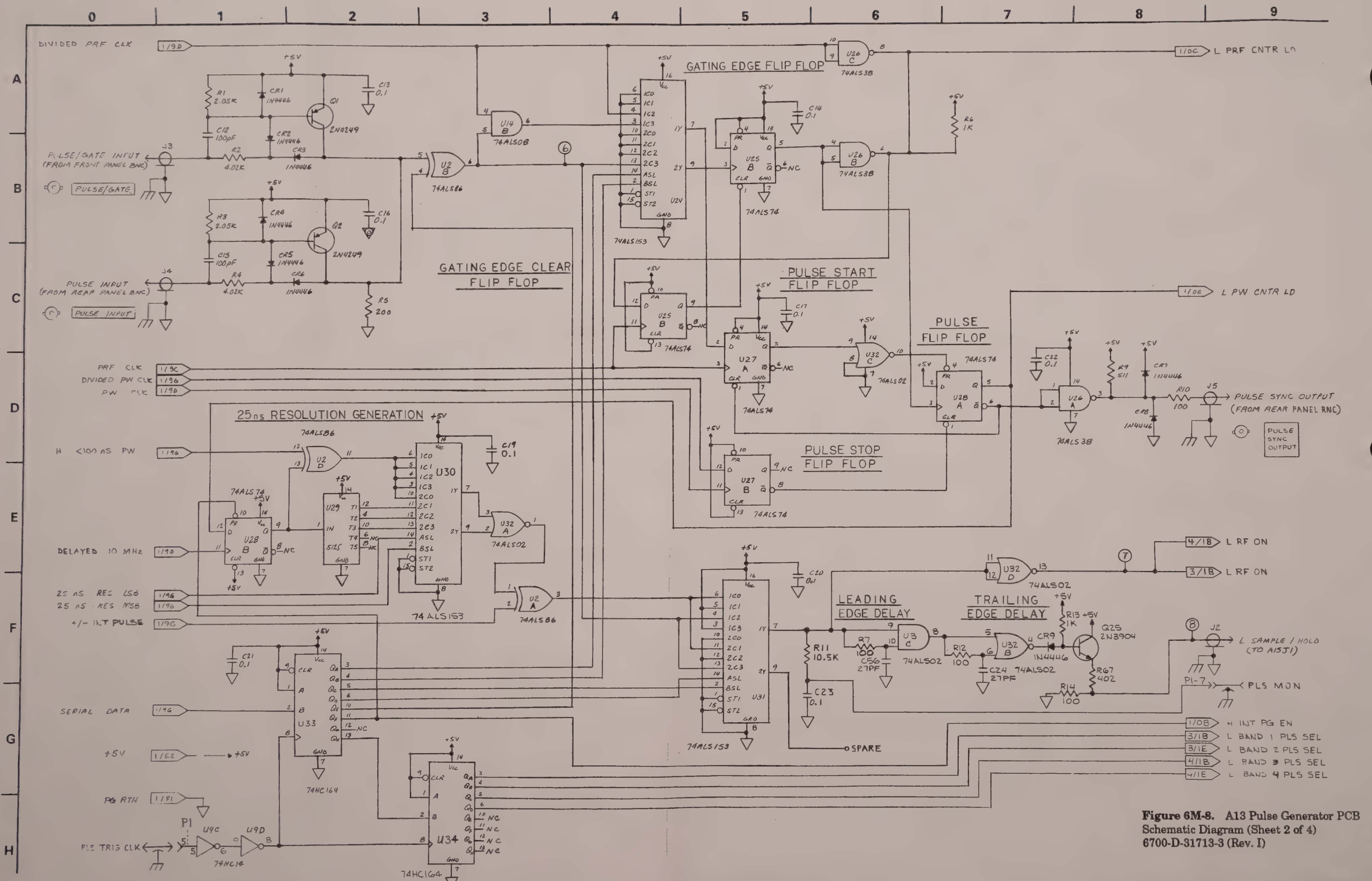

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
DIVIDED PRF CLK
1/9D
PULSE/GATE INPUT (FROM FRONT PANEL BNC)
PULSE/GATE
PULSE INPUT (FROM REAR PANEL BNC)
PULSE INPUT
J3
J4
R1 2.05K
CR1 1N4446
Q1 2N4249
C13 0.1
C12 100pF
CR2 1N4446
R2 4.02K
CR3 1N4446
R3 2.05K
CR4 1N4446
Q2 2N4249
C16 0.1
C15 100pF
CR5 1N4446
R4 4.02K
CR6 1N4446
R5 200
U14 B 74ALS08
U2 B 74ALS86
GATING EDGE FLIP FLOP
U24 74ALS153
U26 C 74ALS38
U25 B 74ALS74
C14 0.1
U26 B 74ALS38
R6 1K
1/10C L PRF CNTR LD
GATING EDGE CLEAR FLIP FLOP
PULSE START FLIP FLOP
U25 B 74ALS74
U27 A 74ALS74
C17 0.1
U32 C 74ALS02
PULSE FLIP FLOP
U28 A 74ALS74
C22 0.1
U26 A 74ALS38
R9 511
CR7 1N4446
CR8 1N4446
R10 100
J5
PULSE SYNC OUTPUT (FROM REAR PANEL BNC)
PULSE SYNC OUTPUT
1/10E L PW CNTR LD
PRF CLK 1/9C
DIVIDED PW CLK 1/9G
PW CLK 1/9D
PULSE STOP FLIP FLOP
U27 B 74ALS74
25ns RESOLUTION GENERATION
H <100 nS PW 1/9G
U2 D 74ALS86
U30 74ALS153
C19 0.1
U28 B 74ALS74
U29 5125
U32 A 74ALS02
DELAYED 10 MHz 1/9D
25 nS RES LSB 1/9G
25 nS RES MSB 1/9G
+/- INT PULSE 1/9G
U2 A 74ALS86
C21 0.1
U33 74HC164
SERIAL DATA 1/9G
+5V 1/E2
PG RTN 1/F1
P1
PLS TRIG CLK
U9C U9D 74HC14
U34 74HC164
U31 74ALS153
C20 0.1
R11 10.5K
C23 0.1
SPARE
U32 D 74ALS02
4/1B L RF ON
3/1B L RF ON
LEADING EDGE DELAY
TRAILING EDGE DELAY
U3 C 74ALS02
R7 100
C56 27PF
R12 100
C24 27PF
U32 B 74ALS02
CR9 1N4446
R13 1K
Q25 2N3904
R67 402
R14 100
J2
L SAMPLE / HOLD (TO A15J1)
P1-7
PLS MON
1/10B H INT PG EN
3/1B L BAND 1 PLS SEL
3/1E L BAND 2 PLS SEL
4/1B L BAND 3 PLS SEL
4/1E L BAND 4 PLS SEL

Figure 6M-8. A13 Pulse Generator PCB Schematic Diagram (Sheet 2 of 4) 6700-D-31713-3 (Rev. I)

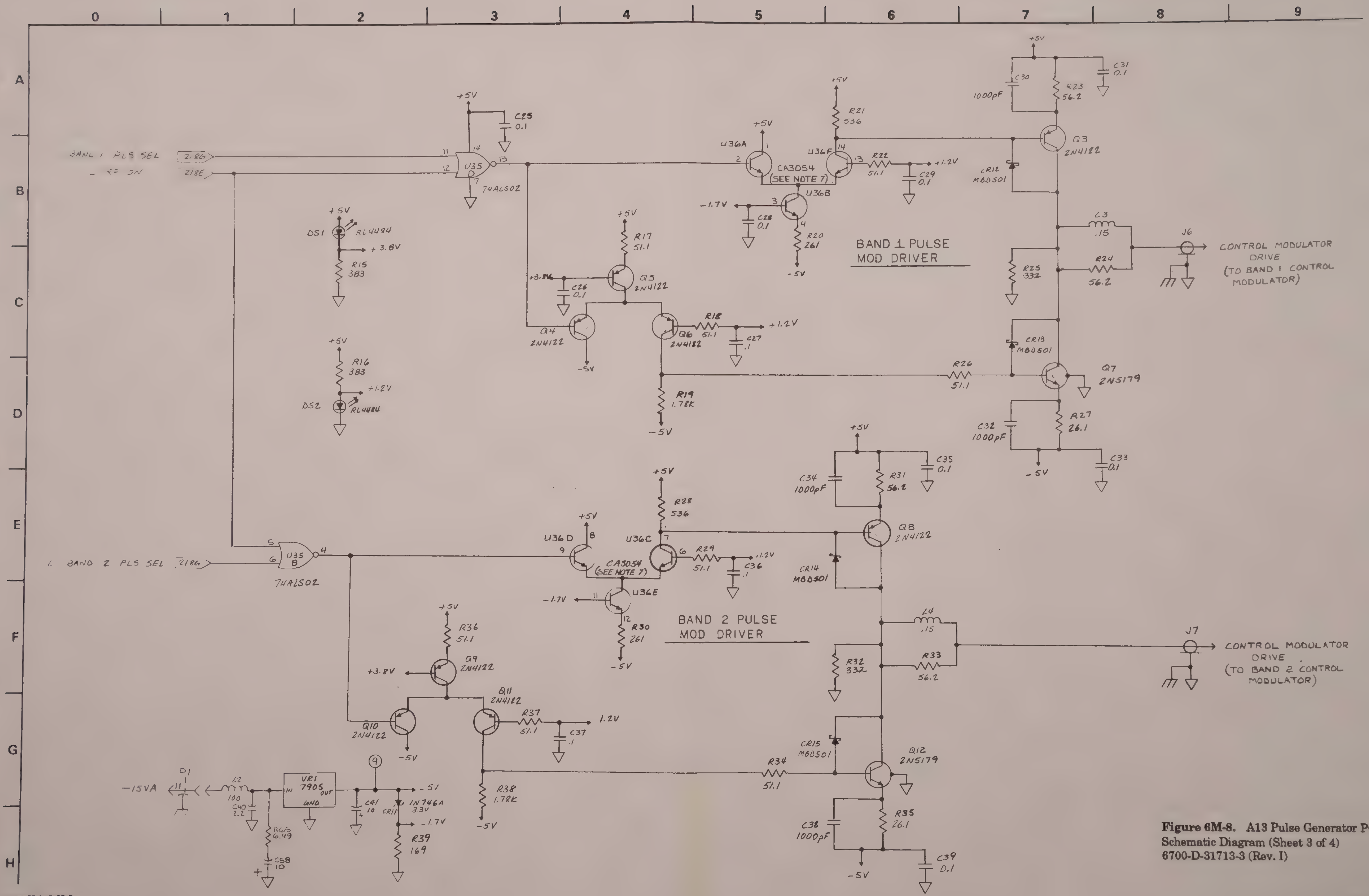

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
BAND 1 PLS SEL
RF ON
218G
218E
U35 D
74ALS02
U35 B
74ALS02
L BAND 2 PLS SEL
218G
+5V
C25 0.1
DS1 RL4484
+3.8V
R15 383
R16 383
+1.2V
DS2 RL4484
U36A
U36F
U36B
CA3054 (SEE NOTE 7)
R21 536
R22 51.1
+1.2V
C29 0.1
-1.7V
C28 0.1
R20 261
-5V
BAND 1 PULSE MOD DRIVER
C30 1000pF
R23 56.2
C31 0.1
Q3 2N4122
CR12 MBD501
L3 .15
R24 56.2
R25 332
J6
CONTROL MODULATOR DRIVE (TO BAND 1 CONTROL MODULATOR)
R17 51.1
Q5 2N4122
+3.8V
C26 0.1
Q4 2N4122
Q6 2N4122
R18 51.1
C27 .1
R19 1.78K
CR13 MBD501
R26 51.1
Q7 2N5179
C32 1000pF
R27 26.1
C33 0.1
C34 1000pF
R31 56.2
C35 0.1
R28 536
U36D
U36C
CA3054 (SEE NOTE 7)
R29 51.1
C36 .1
U36E
R30 261
Q8 2N4122
CR14 MBD501
BAND 2 PULSE MOD DRIVER
L4 .15
R32 332
R33 56.2
J7
CONTROL MODULATOR DRIVE (TO BAND 2 CONTROL MODULATOR)
R36 51.1
Q9 2N4122
Q10 2N4122
Q11 2N4122
R37 51.1
C37 .1
1.2V
R38 1.78K
CR15 MBD501
R34 51.1
Q12 2N5179
C38 1000pF
R35 26.1
C39 0.1
P1
-15VA
L2 100
C40 2.2
R65 6.49
C58 10
VR1 7905
IN OUT GND
9
C41 10
CR11 IN746A 3.3V
-1.7V
R39 169

Figure 6M-8. A13 Pulse Generator PCB Schematic Diagram (Sheet 3 of 4) 6700-D-31713-3 (Rev. I)

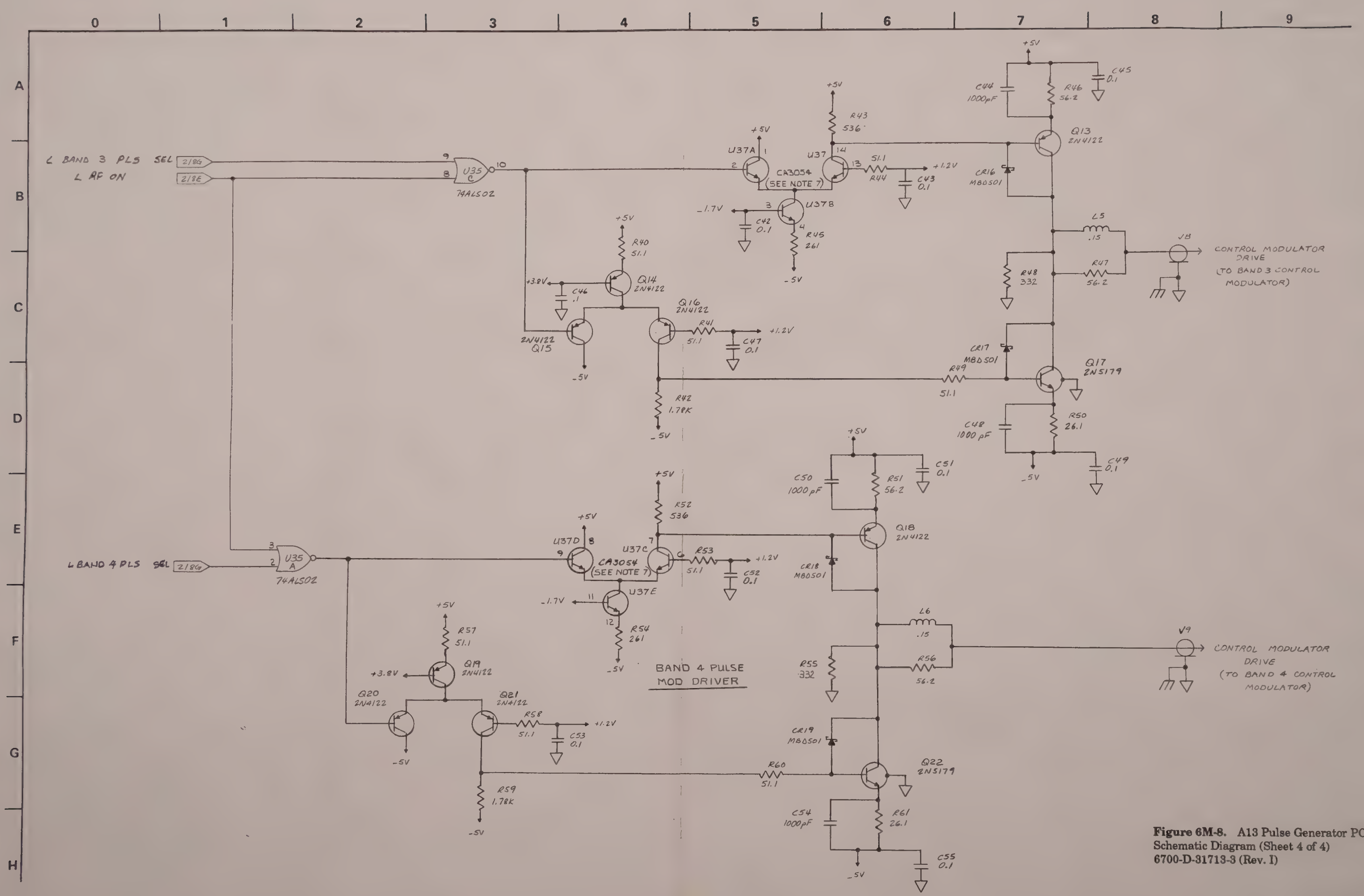

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
L BAND 3 PLS SEL
L RF ON
218G
218E
U35 C
74ALS02
9
8
10
+5V
U37A
1
2
CA3054
(SEE NOTE 7)
U37
14
13
R43
536
51.1
R44
+1.2V
C43
0.1
-1.7V
3
U37B
4
C42
0.1
R45
261
-5V
+5V
C44
1000pF
R46
56.2
C45
0.1
Q13
2N4122
CR16
MBD501
L5
.15
J8
CONTROL MODULATOR DRIVE
(TO BAND 3 CONTROL MODULATOR)
R48
332
R47
56.2
+5V
R40
51.1
+3.8V
Q14
2N4122
C46
.1
Q16
2N4122
R41
51.1
+1.2V
C47
0.1
2N4122
Q15
-5V
R42
1.78K
-5V
CR17
MBD501
R49
51.1
Q17
2N5179
C48
1000 pF
R50
26.1
-5V
C49
0.1
+5V
C50
1000pF
R51
56.2
C51
0.1
+5V
R52
536
+5V
U37D
8
9
U37C
7
6
CA3054
(SEE NOTE 7)
R53
51.1
+1.2V
C52
0.1
Q18
2N4122
CR18
MBD501
L BAND 4 PLS SEL
218G
3
2
U35
A
74ALS02
-1.7V
11
U37E
12
R54
261
-5V
L6
.15
J9
CONTROL MODULATOR DRIVE
(TO BAND 4 CONTROL MODULATOR)
R55
332
R56
56.2
+5V
R57
51.1
Q19
2N4122
+3.8V
BAND 4 PULSE MOD DRIVER
Q20
2N4122
Q21
2N4122
R58
51.1
+1.2V
C53
0.1
-5V
CR19
MBD501
R60
51.1
Q22
2N5179
R59
1.78K
-5V
C54
1000pF
R61
26.1
C55
0.1
-5V

Figure 6M-8. A13 Pulse Generator PCB Schematic Diagram (Sheet 4 of 4)
6700-D-31713-3 (Rev. I)

6N–POWER SUPPLY: A22, A25, A26, AND PART OF A28 PCBS

6N-1 POWER SUPPLY ASSEMBLIES: A22, A25, AND Part of A28 PCBs

This section contains service information for the power supply assemblies listed in Table 6N-1 below. Refer also to Section 6P-Motherboard/Interconnections and to the general reference information in sections 6A, 6B, and 6C.

Table 6N-1. Power Supply Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6N-2	6N-1
Detailed Circuit Description	Para. 6N-3	6N-2
Block Diagram	Fig. 6N-4	6N-11
Troubleshooting	Tbl. 6N-2	6N-7
PCB LEVEL		
A22 Regulator Interface PCB		
Detailed Circuit Description	Para. 6N-5	6N-5
Troubleshooting	Tbl. 6N-2	6N-7
Parts Locator Diagram	Fig. 6N-5	6N-12
Schematic (Sheet 1 of 1)	Fig. 6N-6	6N-13
(Sheet 2 of 2)	"	6N-15
A25 Switching Power Supply		
Detailed Circuit Description	Para. 6N-4	6N-3
Troubleshooting	Tbl. 6N-2	6N-7
Parts Locator Diagram	Fig. 6N-7	6N-16
Schematic (Sheet 1 of 1)	Fig. 6N-8	6N-17
(Sheet 2 of 2)	"	6N-19
A26 Line Filter PCB		
Parts Locator Diagram	Fig. 6N-11	6N-22
Schematic (Sheet 1 of 1)	Fig. 6N-12	6N-23
A28 Motherboard PCB		
Detailed Circuit Description	Para. 6N-6	6N-6
Troubleshooting	Tbl. 6N-2	6N-7
Parts Locator Diagram	Fig. 6N-9	6N-20
Schematic (Sheet 1 of 1)	Fig. 6N-10	6N-21

6N-2 POWER SUPPLY ASSEMBLIES, OVERALL DESCRIPTION

Refer primarily to the power supply block diagram in Figure 6N-4 (located on page 6N-11) for the following discussion.

The Power Supply assemblies include the A22 Regulator Interface PCB, the A25 Switching Power Supply PCB, the A26 Line Filter, and parts of the A28 Motherboard PCB.

WARNING

> Voltages hazardous to life are present throughout the Power Supply circuits, *even when the front panel POWER switch is in STANDBY position.*
>
> The ac line voltage and the +24 Vdc are always present whenever the line cord is connected to the ac line voltage source. Use utmost care to avoid electrical shock anytime maintenance procedures are performed.

The Power Supply subsystem is comprised of a switching +5V converter power supply that provides +9V, ±15V, ±18V, +22V, +24V, and –43V regulated voltages. A +24 Vdc *standby* power supply is also included (+24 Vdc is *always* present whenever the synthesizer is connected to the ac line). The circuits/components that comprise the power supply subsystem are dispersed among the following PCBs and assemblies:

- ***A22 Regulator PCB*** – This PCB contains the +24V, ±15 VA, ±15 VG, ±15 VFM, ±15 VLP, –18V, –18 VG and –43V supply regulator circuits. In addition, two power supply status monitor lines, PS MON1 and PS MON2 are routed to the A23 Microprocessor PCB via the A17 Analog Instruction PCB; these lines signal any failure of the power supply circuits.
- ***A25 Switching Power Supply PCB*** – This PCB contains the 50 kHz switching regulator power supply that provides the +5 VD, +9 VLP and +22V outputs that are routed via the A28 Motherboard throughout the synthesizer. It also supplies other voltages to the A22 PCB that are reduced/regulated to lower voltages (Figure 6N-4).
- ***A26 Line Filter/Rear Panel Assembly*** – This PCB interfaces the rear panel AC Line Connector/EMI Filter, LINE SELECT switch, line fuses, and line power transformer to the power supply circuits.

- ***Part of A28 Motherboard PCB*** – The power supply circuits located on the A28 Motherboard PCB are: Line Rectifier, +30V supply bridge rectifier, A28K1 LINE-switch relay, and the dc fan driver circuits.

6N-3 POWER SUPPLY ASSEMBLIES, DETAILED DESCRIPTION

As shown in the block diagram in Figure 6N-4, line power (90-130 Vac or 180-260 Vac) is connected to the synthesizer via the rear panel AC Line Connector/EMI Filter and is routed through the A26 Line Filter Module, LINE SELECT switch and line fuse to the power line transformer (mounted on the rear panel assembly). When activated, the LINE-switch relay connects the ac line voltage to the line rectifier located on the A28 Motherboard PCB. This rectifier supplies ±165 Vdc (unregulated) to the A25 Power Supply PCB.

The line power transformer supplies approximately 30 Vac to the +30 Vdc bridge rectifier circuit located on the A28 Motherboard PCB. The unregulated +30 Vdc from this circuit is routed to the dc fan switching circuits and to the input of the +24V regulator on the A22 Regulator PCB.

On the A22 PCB, the +30 Vdc is regulated to +24 Vdc and routed to the 10 MHz reference oscillator oven heater and to the front panel LINE switch. When the LINE switch is depressed (ON), the +24 Vdc is applied to the A28K1 LINE-switch relay and to transistor A28Q2 of the dc fan driver circuit

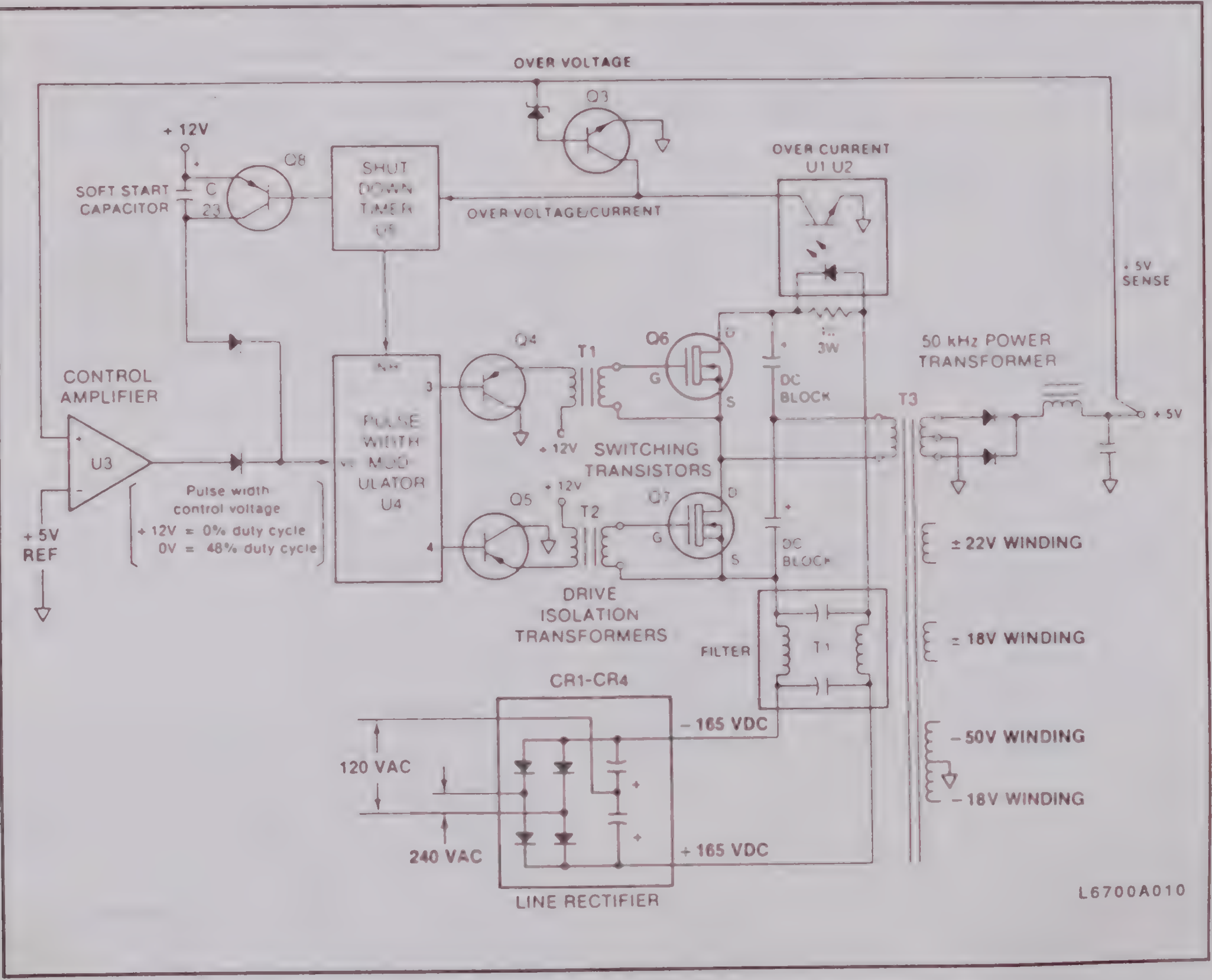

OVER VOLTAGE
Q3
+12V
Q8
SOFT START CAPACITOR
C 23
SHUT DOWN TIMER U5
OVER CURRENT U1 U2
OVER VOLTAGE/CURRENT
+5V SENSE
Q4
T1
Q6
D
G
S
3W
DC BLOCK
50 kHz POWER TRANSFORMER
T3
+5V
CONTROL AMPLIFIER
U3
PULSE WIDTH MODULATOR U4
3
4
+12V
SWITCHING TRANSISTORS
Pulse width control voltage
+12V = 0% duty cycle
0V = 48% duty cycle
+5V REF
Q5
T2
Q7
DC BLOCK
±22V WINDING
±18V WINDING
DRIVE ISOLATION TRANSFORMERS
FILTER
T1
CR1-CR4
-165 VDC
-50V WINDING
-18V WINDING
120 VAC
240 VAC
+165 VDC
LINE RECTIFIER
L6700A010

Figure 6N-1. Simplified Schematic of Switching Power Supply

(see the bottom portion of the A28 PCB schematic, Figure 6N-10). When +24 Vdc is applied, A28Q2 turns on A28Q3 which applies the unregulated +30 Vdc to the dc fan.

NOTE

Early 67XXA models have a slightly different A26 Line Filter PCB circuit configuration and a different dc fan switching circuit; please contact WILTRON Customer Service for schematic details.

The LINE-switch relay, A28K1, connects the ac line voltage to the Line Rectifier circuit. As determined by the LINE SELECT switch, this circuit functions either as a full-wave voltage doubler (90-130 Vac line) or as a full-wave bridge rectifier (180-260 Vac line). In either mode of operation, the Line Rectifier circuit outputs +165 Vdc and –165 Vdc voltages that are filtered by A28FL1 and routed to the A25 Power Supply PCB.

6N-4 A25 SWITCHING POWER SUPPLY, DETAILED CIRCUIT DESCRIPTION

Refer to the simplified schematic of the switching power supply shown in Figure 6N-1; refer also to Figure 6N-2 and to the schematic diagram Figure 6N-8 (sheets 1 and 2), for the following description. The A25 PCB contains the following circuits:

- +165 Vdc Filter,
- Overcurrent Sense circuit,
- 50 kHz Generator (pulse-width modulator and control transistors),
- Switching Transistors,
- Control Amplifier,
- Shut-Down Timer and Soft-Start Control,
- +5V Overvoltage Detector,
- Temperature Detector,
- Out-of-Reg Sense circuits.

Switching transistors A25Q6 and Q7 (shown in Figure 6N-1 and detailed in Figure 6N-2), alternately switch between +165 Vdc and –165 Vdc at a 50 kHz rate. The outputs from Q6 and Q7 form a composite waveform (Figure 6N-2).

The peak-to-peak value of this waveform is directly proportional to the peak value of the input ac line voltage. This waveform is coupled to the five secondary windings of transformer A25T3, as shown in Figure 6N-1.

The reduced voltages in the secondary A25T3 windings, like the output of Q6 and Q7, are proportional to the input line voltage. These reduced voltages are rectified and passed through inductors that function as integrators. The output voltages from these inductors are proportional to both the line voltage and the duty cycle of the output from the pulse width modulator circuit.

As shown in Figure 6N-1, the simplified schematic of the switching power supply, the Pulse Width

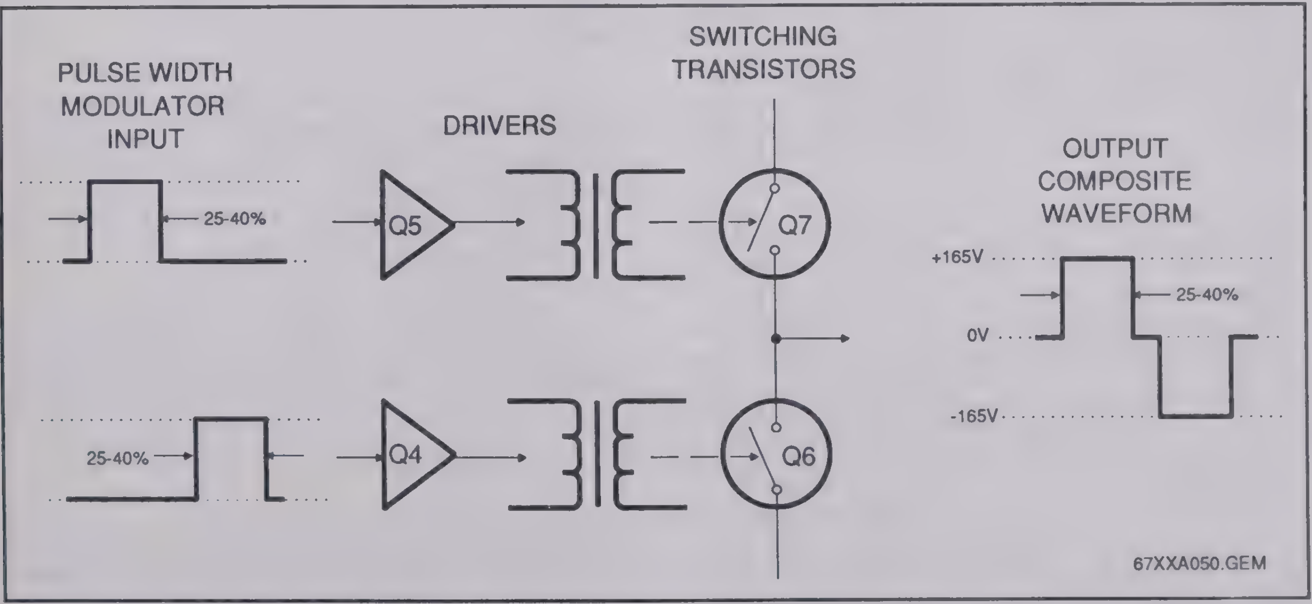


Figure 6N-2. Switching Transistors and Drivers

Modulator (PWM) integrated circuit, (U4) controls the on/off ratio of the switching transistors. It develops a train of pulses with a duty cycle that varies between 25% and 40% (approximately). This duty cycle depends on the amplitude of the PWM control voltage, Vc. The amplitude of this voltage is determined by either the Shut-Down Timer and Soft Start circuit or the Control Amplifier.

The Control Amplifier monitors the output from the +5V supply and uses it to control the duty cycle of the Pulse Width Modulator. The input to this amplifier is the +5V SENSE line from the A28 Motherboard; it senses the voltage across the load of the +5 VD supply. The output of the amplifier is a 0-12V signal that forces the PWM to output the correct duty cycle to maintain +5V at the sense line.

The Soft Start portion of the Shut Down Timer and Soft Start circuit cause the +5 VD supply to come on line at its minimum voltage level (soft start).

The input to this circuit is +12 Vdc from the +12V regulator. At the instant the LINE switch is depressed, +12V is applied to the Vc pin of Q4 through C23. (See the A25 schematic, sheet 1; note that C8 is effectively across the emitter and collector of Q8.) With the Vc pin at +12V, the duty cycle of the PWM output pulse train is at its minimum, thus causing the output of the +5 VD supply to be at its minimum level. As C23 charges, the subsequently decreasing voltage at the Vc pin causes the duty cycle of the output pulse train to increase. This decreasing Vc voltage, in turn, causes the +5 VD supply output voltage to rise. When the Control Amplifier senses that +5 VD SENSE has been reached (approximately 20 ms), power supply regulation occurs.

The Shut Down Timer portion of the Shut Down Timer and Soft Start circuit shuts down the switching power supply when overvoltage, overcurrent, or overtemperature conditions occur. Overcurrent conditions in the switching power supply circuits are sensed by photo-coupler circuits, U1 and U2. Overvoltage and undervoltage conditions on the +5 VD output are sensed by zener diode CR8 and operational amplifier U3. Any overvoltage condition on the +22V is sensed by zener diodes CR2 and CR19 (and Q12). Any overtemperature condition of the switching transistors is sensed by thermistor RT1, which causes Q2 and Q1 to switch state when an overtemperature condition occurs.

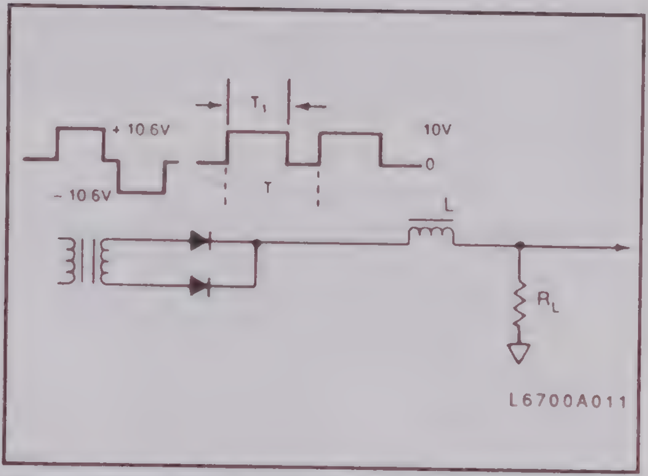


Figure 6N-3. Typical A25 PCB Rectifier/Filter Circuit

The input to the Shut Down Timer, U5, is the common collector outputs of U1, U2, Q3 and Q12, which are part of the overvoltage and overcurrent circuits. The heat sensing switch located on the microwave deck is also connected to this line. If an overvoltage, overcurrent, or overtemperature condition is sensed, this line goes low and causes the Shut Down Timer, U5, to generate a pulse having a pulse width of approximately 1 second.

The leading edge of the one second pulse causes the Vc pin of Q4 to go to +12V and the INH pin to go low. This causes Q4 to turn off, which shuts down the switching transistors. The lagging edge of the one second pulse causes the INH pin of Q4 to return high, which causes the switching power supply to soft-start.

If the overvoltage/overcurrent condition that started the above cycle is still present, U5 generates another pulse and again causes the supply to shut down. This cycling operation continues until the overvoltage or overcurrent condition is corrected or the LINE switch is pressed to STANDBY.

The +18 VG, –18 VG, –21V and –43V outputs from the A25 Switching Power Supply PCB are routed to the regulators on the A22 PCB via the transformer secondary filter circuits shown on sheet 2 of the A25 PCB schematic. A typical A25 filter circuit is shown in Figure 6N-3.

This same type of circuit is also used to filter the +5 VD supply. The composite waveform is coupled through transformer T3 to the secondary circuits. These reduced voltages are rectified and passed through an inductor which is used as an integrator. The value of the voltage that is output from the inductor can be controlled entirely by time T1 shown in Figure 6N-3. Time T1 is effectively the duty cycle of the pulse width modulator circuit. The peak-to-peak magnitude of the output pulses is also directly proportional to the peak value of the ac mains input voltage.

The output voltage distribution of the A25 PCB is as follows:

- The –50V rectifier supplies the –43V regulator located on the A22 Regulator PCB.
- The +22V rectifier supplies a +22V unregulated voltage to the motherboard.
- The –18 VG rectifier supplies the –15V A, G, and (FM) regulators located on the A22 Regulator PCB.
- The +18 VG rectifier supply the +15V A, G, and (FM) regulators located on the A22 Regulator PCB.
- The –21V rectifier supplies the –18V (tuning voltage) regulator located on the A22 Regulator PCB.
- The +9 VLP supplies an unregulated +9V to the +5V regulators located on the RF casting's A5, A6, A7, A10, A11 and A12 phase lock assemblies.

6N-5 A22 REGULATOR INTERFACE PCB, DETAILED CIRCUIT DESCRIPTION

Refer to Figure 6N-6, sheets 1 and 2, for the following description.

a. +24V Supply

The unregulated +30 Vdc from the A28 Motherboard is connected to the input of the three-terminal regulator integrated circuit, A22 VR1. The output voltage of VR1 is set by the voltage applied to the ADJ pin; this voltage is set by the ratio of R1 and R2. Capacitor C2 reduces the noise output of the regulator. The output of the +24V supply is routed via the Motherboard to the 10 MHz Reference Oscillator oven heater, the A28K1 LINE-switch relay and is used to derive the tuning voltage for the A5 Reference Oscillator. The output of this supply is designated *as +24 V1*; after the LINE-switch, it is designated as *+24 VG*.

b. –18V Supply

The –18V supply provides current for the YIG tuning current drivers on the A18 through A21 YIG Driver PCBs. Integrated circuit VR2 is a precision 10V regulator that supplies the reference voltage for both the –18V and –43V power supplies. As a negative regulator, it is configured as a zener diode. The GND terminal of VR2 has –10V which goes to U1-2. U1B is the control amplifier for the –18V supply. Since U1-3 must be at –10V, the ratio of R12 to R13 will set the output voltage at –18V.

Transistor Q3 acts as a level shifter as the output voltage of U1B cannot swing above its supply limit. Zener diode CR1 supplies a bias to Q3 during start up before U1-4 voltage reaches –18V. Transistor Q3 drives Q1, which is the series pass transistor for the –18V supply. Transistor Q2, in conjunction with R6 and R7, provides for current limiting at approximately 3A.

Transistor Q8 provides for a foldback in the current limit; that is, as the supply goes into current limit and the output voltage drops below approximately 12V, Q8 will begin conducting which increases the conduction of Q2 and reduces the conduction of Q1. Under short circuit conditions, the current limit of the –18V supply is approximately 300 mA. This foldback action reduces power dissipation in Q1 from approximately 60 watts to approximately 6 watts under short circuit conditions.

c. –43V Supply

The –43V supplies the tuning current drivers on the A18 through A21 YIG Driver PCBs. The current is normally less than 10 mA, however, during fast analog sweeps or step sweep operation, the current output can reach up to (approximately) 1A. The operation of this supply is identical to the –18V supply but is current limited to approximately 1.2A by R17 and Q4. The foldback begins operating at about –29.4V and, under short circuit conditions, limits the output current to approximately 200 mA. This reduces the power dissipation of Q5 from approximately 50 watts to approximately 8 watts under short circuit conditions.

Since VR2 also supplies the reference for the –43V supply, the –18V supply must be operating in order for the –43V supply to operate. This prevents overloading of the –43V supply by the A18 through A21 YIG Drivers in case of a failure in the –18V supply.

d. +15V and –15V Supplies

All of the other supplies on the A22 board are fixed regulators. They have built-in current limiting at approximately 1.5A and built-in current foldback.

e. +22V Supply

The +22V is routed onto the A22 PCB for a test point only. This is an unregulated supply that is used as the source for the bias regulators on the A18 through A21 YIG Driver PCBs. It is also used for the (optional) step attenuator driver on the A29 Rear Panel Interface PCB.

f. +9 VLP Supply

This is an unregulated supply that is used in some of the +5V regulators in the phase lock circuitry located in the RF casting.

g. Power Supply Monitor Circuit

All of the power supply voltages, except the +5V, are summed into U2A and U2B inverting op amps. The output of these amplifiers will be 0V when all of the voltages are at their proper level. If one of the power supplies has no output, the effective weighting value of its resistor input to the op amp will yield a distinct output that is interpreted by the DVM circuit on the A17 Analog Instruction PCB. This provides the signal source for error codes for the power supply during instrument Self Test.

6N-6 A28 MOTHERBOARD PCB POWER SUPPLY CIRCUITS, DETAILED CIRCUIT DESCRIPTION

Refer to the schematic of the A28 Motherboard PCB (Figure 6N-10) for the following descriptions. Note that additional A28 Motherboard PCB information is presented in section 6P–Motherboard/Interconnections; only specific power supply information is presented here.

a. Line Rectifier

The LINE-switch relay, A28K1, connects the ac line voltage to the Line Rectifier circuit comprised of power diodes CR1-CR4. In the "10" position of the LINE SELECT switch, this circuit functions as a full-wave voltage doubler; in the "220" position of the LINE SELECT switch it functions as a full-wave bridge rectifier. Capacitors C3 and C4 are filter capacitors for the rectified line voltage. FL1 filters out the 50 kHz switching transients from the switching power supply to prevent them from getting onto the ac power line. In both modes of operation, this circuit outputs +165 Vdc and –165 Vdc voltages that are routed to the A25 Power Supply PCB.

b. +30 V Rectifier

The line power transformer supplies approximately 30 Vac to power diodes CR6–CR9 that comprise the bridge rectifier circuit for the +30V power supply. The unregulated +30 Vdc output from this circuit is routed to the A22 Regulator PCB, where it is regulated to +24V. Transistor Q4 converts the 30 Vac to TTL levels that are used by the A23 Microprocessor for synchronizing the sweep to power line frequency.

c. Fan Driver Circuits

When +24 Vdc is applied from the LINE switch, Q2 turns on Q3 which applies the unregulated +30 Vdc to the dc fan. In the STANDBY mode, Q2 and Q3 are shut off, and no +30 Vdc power is applied to the dc fan.

6N-7 POWER SUPPLY ASSEMBLIES, TROUBLESHOOTING

Table 6N-2 contains the troubleshooting procedures for the A22 Regulator Interface PCB, the A25 Switching Power Supply PCB, and the power supply circuits located on the A28 Motherboard PCB. Although not specifically referenced in Table 6N-2, the troubleshooting for the primary power circuits of the synthesizer and the A26 Line Filter PCB is inherent in these procedures.

6N-8 POWER SUPPLY ASSEMBLIES, SERVICE SHEETS

Table 6N-1 on the first page of this section references the block diagrams, schematic diagrams, and parts locator diagrams for the A22, A25, A26, and A28 PCBs.

Table 6N-2. Power Supply Troubleshooting (1 of 4)

<table>
<tr><th>Trouble / Error Code</th><th>Troubleshooting Procedure</th></tr>
<tr><td></td><td><i>General Power Supply Troubleshooting
When 67XXA Does Not Power Up</i></td></tr>
<tr><td>STANDBY Light is Off</td><td>Remove ac power; check both line fuses on rear panel.
• If the line fuses are okay, check A22TP11 for +24V.
• If the +24V is okay, check the A28J1 connection to the front panel casting. If this is okay, then there is an open in the cabling between the front panel casting and the A1 and A2 PCBs.
• If there is no +24V at A22TP11, disconnect A28J3 and A28J1. If the +24V appears, then there is a short circuit in either the front panel casting PCBs or the 10 MHz Crystal Oscillator.
• If the +24V does not appear, the problem is with the rear panel line power transformer (T1), A22VR1, or A28CR6-9.</td></tr>
<tr><td>STANDBY Light is On</td><td>When LINE is pressed, the STANDBY light should go off and the ON light should illuminate.
• If STANDBY goes off and the ON light remains off, it indicates either the LINE switch is defective or there is a short circuit on the +24V after the LINE switch.
• If the STANDBY light goes off and the ON light illuminates as normal, there should be an audible click of the A28K1 relay energizing. If A28K1 does not click but the fan is operating, A28K1 is defective. If the fan is not operating, the cabling from the front panel casting through A28J2 is most likely open.</td></tr>
<tr><td>Front panel LCDs and LEDs flash on and off when LINE is switched to ON</td><td>Indicates one of the A25 power supply outputs is shorted to ground. The table below shows the resistance to ground of A25 outputs with A25 installed. The cause of the short circuit may be localized to board or sub-system level by removing the PCBs until the short circuit goes away. (All readings taken between ground and the connector point on a 1 kOhm scale. Ohmmeter negative lead to ground, positive lead to test point.)
<table>
<tr><th><i>Connection</i></th><th><i>Signal</i></th><th><i>Resistance to Ground</i></th><th><i>Action</i></th></tr>
<tr><td>XA25P2-1</td><td>+5V</td><td>60 Ω</td><td>Remove: A28J1, A8, A13, A15, A16, A17, A23, A24, A28J19</td></tr>
<tr><td>XA25P2-29</td><td>–50V</td><td>14 kΩ</td><td>Remove: A22</td></tr>
<tr><td>XA25P2-25</td><td>–18V</td><td>3 kΩ</td><td>Remove: A22</td></tr>
<tr><td>XA25P2-23</td><td>+22V</td><td>143 Ω</td><td>Remove: A18, A19, A20, A21, A22, A28J19, A28Q4</td></tr>
<tr><td>XA25P2-11</td><td>+18V</td><td>490 Ω</td><td>Remove: A22</td></tr>
<tr><td>XA25P2-15</td><td>–18V</td><td>38 kΩ</td><td>Remove: A22</td></tr>
<tr><td>XA25P2-9</td><td>+9V</td><td>465 Ω</td><td>Remove: A6, A7, A11, A12, A22</td></tr>
</table></td></tr>
</table>

Table 6N-2. Power Supply Troubleshooting (2 of 4)

<table>
<tr><th>Trouble / Error Code</th><th>Troubleshooting Procedure</th></tr>
<tr><td></td><td>Power Supply Error Code Troubleshooting</td></tr>
<tr><td>E00</td><td>The processor tests the A17 Analog Instruction PCB's digital voltmeter circuit (DVM) for E17-10 through E17-13 errors. If it cannot then discern the problem, it displays error code E00. No other self test can be made if the DVM is inoperative. The cause of the problem can be either the ±15 VG supplies or the DVM itself.

• Check A22TP6 with an external DVM. The DVM should read +15 ±0.75V. If the voltage is out of tolerance, replace A22VR7. If the voltage is 0V then check for a short circuit by removing the A17 through A21 PCBs one at a time. If the short circuit then goes away, troubleshoot the appropriate PCB. Another possibility is A22C23.

• Check A22TP5 with an external DVM. The DVM should read −15 ±0.75V. If the voltage is out of tolerance, replace A22VR8. If the voltage is 0V, then check for a short circuit by removing the A17 through A21 PCBs one at a time. If the short circuit then goes away, troubleshoot the appropriate PCB. Another possibility is A22C25.

If the ±15 VG supplies are within tolerance, refer to Section 6K for DVM troubleshooting procedures.</td></tr>
<tr><td>E22-10 (PS1 MON)</td><td>If the PS MON1 monitor line is at a value other than that the microprocessor expects to see, it assumes the PS MON1 monitor to be defective. The weighting factor of the supplies monitored by the A23 Microprocessor will only indicate detection of a short circuit.

Check the voltages below. If they are out of specification, repair the associated regulator circuit.

<table>
<tr><th>Check</th><th>Read</th><th>Repair</th></tr>
<tr><td>A22TP10</td><td>+15 ±0.75V</td><td>A22VR5</td></tr>
<tr><td>A22TP9</td><td>−15 ±0.75V</td><td>A22VR6</td></tr>
<tr><td>A22TP12</td><td>−18 ±4.0</td><td>A22U1, VR2, Q1</td></tr>
</table>

NOTE

The −18V supply must be operating before the −43V supply can be checked.

<table>
<tr><th>Check</th><th>Read</th><th>Repair</th></tr>
<tr><td>A22TP13</td><td>−43 ±1V</td><td>A22U1, A2CR31</td></tr>
<tr><td>A22TP11</td><td>+24 ±1.25V</td><td>A22VR1</td></tr>
<tr><td>A22TP5</td><td>+15 ±0.75V</td><td>A22VR4</td></tr>
<tr><td>A22P2-7</td><td>+9 ±2V</td><td>A25CR30, A25CR31, and associated circuits</td></tr>
</table>

NOTE

If the voltage is +18V (or close to it), there is no load on this supply. Check for an open from A25P2-9,10 and the A6, A7, A11, and A12 PCBs.

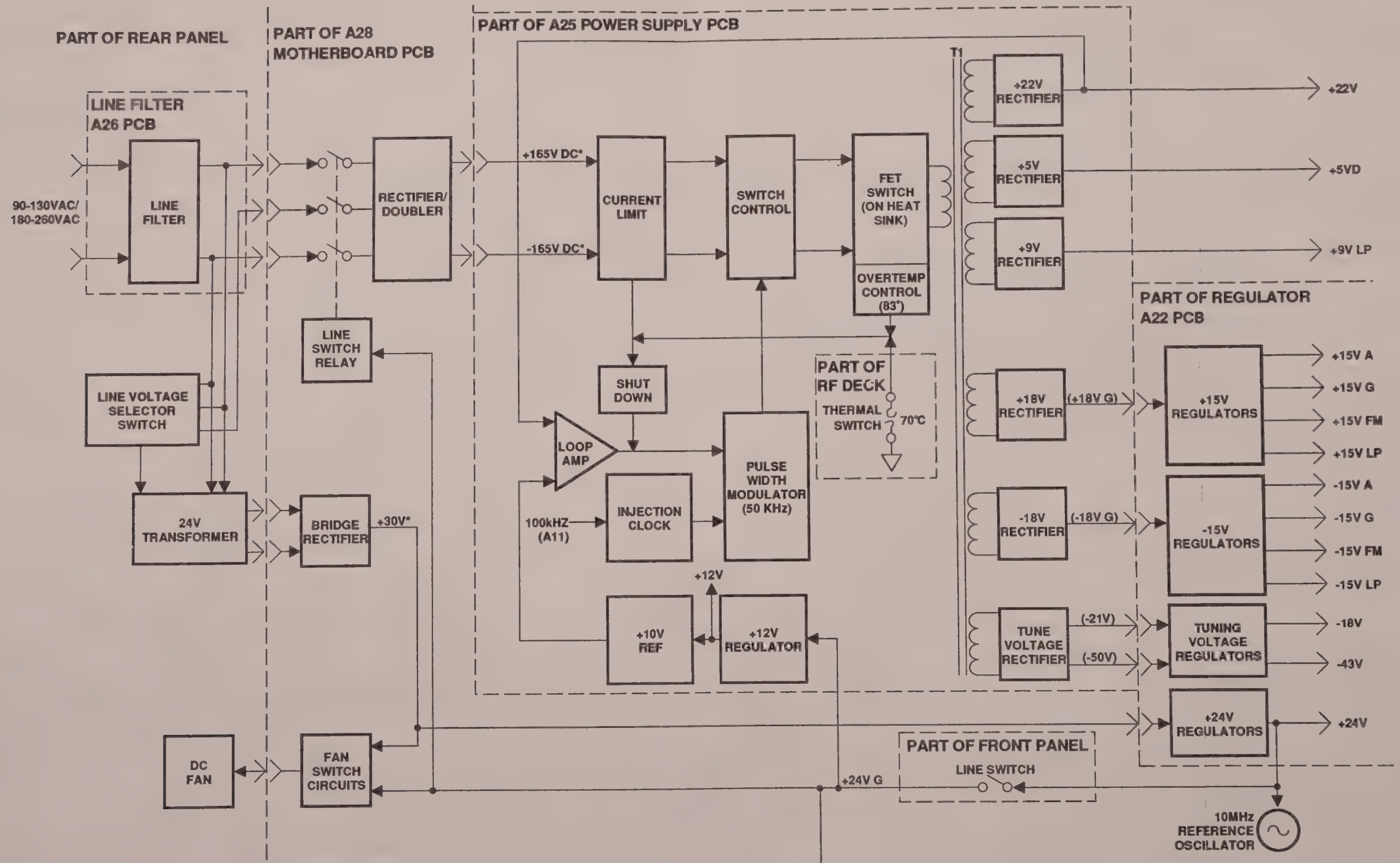
If the above voltages are within tolerance, replace A22U2.</td></tr>
</table>

Table 6N-2. Power Supply Troubleshooting (3 of 4)

Trouble / Error Code	Troubleshooting Procedure
	Power Supply Error Code Troubleshooting (Cont'd)
E22-11 (PS2 MON)	If the PS MON2 monitor line is at a value other than that the A23 Microprocessor expects to see, it assumes the PS MON2 monitor to be defective. The weighting factor of the supplies monitored by the A23 Microprocessor will only indicate detection of a short circuit. - Check the voltages below. If they are out of spec, repair the associated regulator circuit. Check Read Repair A22TP8 +15 ±0.75V A22VR3 A22TP7 –15 ±0.75 A22VR4 A22TP4 +15 ±0.75V A22VR9 A22TP3 –15 ±0.75V A22VR10 A22TP6 +15 ±0.75V A22VR7 A22TP5 +15 ±0.75V A22VR8 If the above voltages are okay, replace A22U2.
E22-20 (+9 VLP)	If the +9 VLP is shorted, the power supply will not start up. This error indicates no output from the A25 +9 VLP supply. - Check A25CR30, A25CR31 and their associated filter capacitors and coils.
E22-21 (+24 V1)	The output of A22VR1 is not applied to the monitor circuit or it is unregulated. - Check A22TP11 for +24 ±1.5V. If out of tolerance, replace A22VR1.
E22-22 (+15V LP)	There is no output from A22VR5. - Check for a short circuit between A22TP10 and ground. - If shorted, remove in turn the A3, A6, A11, A9, A5, A7, and A12 PCBs to isolate the fault. If removal of these boards does not eliminate the short, replace A22C17. - If no short exists, replace A22VR5.
E22-23 (–18V)	There is no output from A22Q1. - Check for a short-circuit between A22TP12 and ground. If shorted, remove in turn the A18, A19, A20, A21 PCBs to isolate the fault. - If removal of these boards does not eliminate the short, replace A22C11. - If no short exists, troubleshoot A22U1 and VR2 associated circuitry. **NOTE** The –18V supply must first be operating before attempting to troubleshoot the –43V supply. If the –18V supply is shorted to ground, it will shut down the –43V supply.
E22-24 (–43V)	There is no output from A22Q5. - Check for a short-circuit between A22TP13 and ground. If short circuited, remove in turn the A18, A19, A20, and A21 PCBs to isolate the fault. - If removal of these boards does not eliminate the short, replace A22C10. - If no short circuit exists, troubleshoot A22U1 and Q5 associated circuits.

Table 6N-2. Power Supply Troubleshooting (4 of 4)

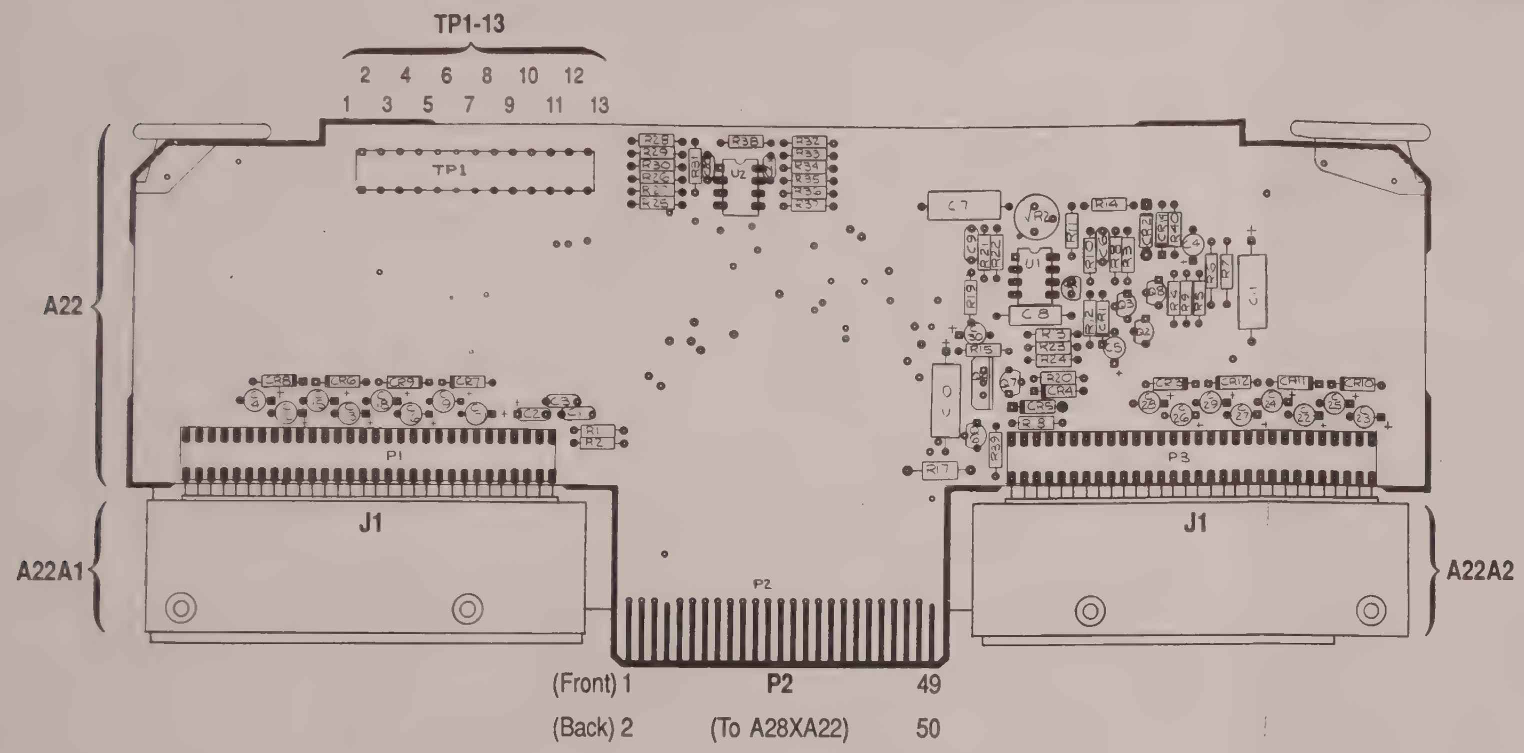
Trouble / Error Code	Troubleshooting Procedure
	Power Supply Error Code Troubleshooting (Cont'd)
E22-25 (+15 VLP)	There is no output from A22VR6. • Check for a short-circuit between A22TP9 and ground. If shorted, remove in turn the A3, A6, A11, A9, A5, A7, and A12 PCBs to isolate the fault. • If removal of these boards does not eliminate the short, replace A22C19. • If no short exists, replace A22VR6.
E22-26 (+15 VFM)	There is no output from A22VR9. • Check for a short-circuit between A22TP4 and ground. If short circuited, remove in turn the A16, A18, A19, A20, and A21 PCBs to isolate the fault. • If removal of these boards does not eliminate the short, replace A22C27. • If no short circuit exists, replace A22VR9.
E22-27 (+15 VA)	There is no output from A22VR3. • Check for a short-circuit between A22TP8 and ground. If shorted, remove in turn the A15 PCB, the A28J19 and J1 connectors, and the A8 PCB to isolate the fault. • If removal of these boards does not eliminate the short, replace A22C13. • If no short circuit exists, replace A22VR3.
E22-28 (–15 VFM)	There is no output from A22VR10. • Check for a short-circuit between A22TP3 and ground. If shorted, remove in turn the A16, A18, A19, A20, and A21 PCBs to isolate the fault. • If removal of these boards does not eliminate the short, replace A22C29. • If no short circuit exists, replace A22VR10.
E22-29 (–15 VA)	There is no output from A22VR4. • Check for a short-circuit between A22TP7 and ground. If shorted circuit exists, remove the A15 PCB, the A28J19 and J1 connectors, the A8, A13 PCBs to isolate the fault. • If removal of these boards does not eliminate the short, replace A22C15. • If no short circuit exists, replace A22VR4.


PART OF REAR PANEL
PART OF A28 MOTHERBOARD PCB
PART OF A25 POWER SUPPLY PCB
LINE FILTER A26 PCB
90-130VAC/ 180-260VAC
LINE FILTER
RECTIFIER/ DOUBLER
+165V DC*
-165V DC*
CURRENT LIMIT
SWITCH CONTROL
FET SWITCH (ON HEAT SINK)
OVERTEMP CONTROL (83°)
T1
+22V RECTIFIER
+5V RECTIFIER
+9V RECTIFIER
+22V
+5VD
+9V LP
LINE SWITCH RELAY
SHUT DOWN
PART OF RF DECK
THERMAL SWITCH
70°C
LINE VOLTAGE SELECTOR SWITCH
LOOP AMP
PULSE WIDTH MODULATOR (50 KHz)
INJECTION CLOCK
100kHZ (A11)
24V TRANSFORMER
BRIDGE RECTIFIER
+30V*
+12V
+10V REF
+12V REGULATOR
PART OF REGULATOR A22 PCB
+18V RECTIFIER
(+18V G)
+15V REGULATORS
+15V A
+15V G
+15V FM
+15V LP
-18V RECTIFIER
(-18V G)
-15V REGULATORS
-15V A
-15V G
-15V FM
-15V LP
TUNE VOLTAGE RECTIFIER
(-21V)
(-50V)
TUNING VOLTAGE REGULATORS
-18V
-43V
+24V REGULATORS
+24V
DC FAN
FAN SWITCH CIRCUITS
PART OF FRONT PANEL
LINE SWITCH
+24V G
10MHz REFERENCE OSCILLATOR
+24V G

* Unregulated voltage

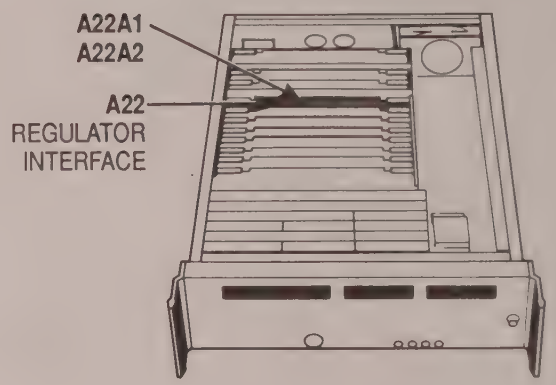
8.0
15.2
74-6

Figure 6N-4. Overall Power Supply Block Diagram


TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
TP1
A22
P1
P3
J1
J1
A22A1
A22A2
P2
(Front) 1
P2
49
(Back) 2
(To A28XA22)
50

TEST POINTS	
TP1	GND G
TP2	+22V
TP3	–15VFM
TP4	+15VFM
TP5	–15VG
TP6	+15VG
TP7	–15VA
TP8	+15VA
TP9	–15VLP
TP10	+15VLP
TP11	+24V1
TP12	–18V
TP13	–43V

All measurements are made with reference to GND G at TP1.


A22A1
A22A2
A22
REGULATOR
INTERFACE

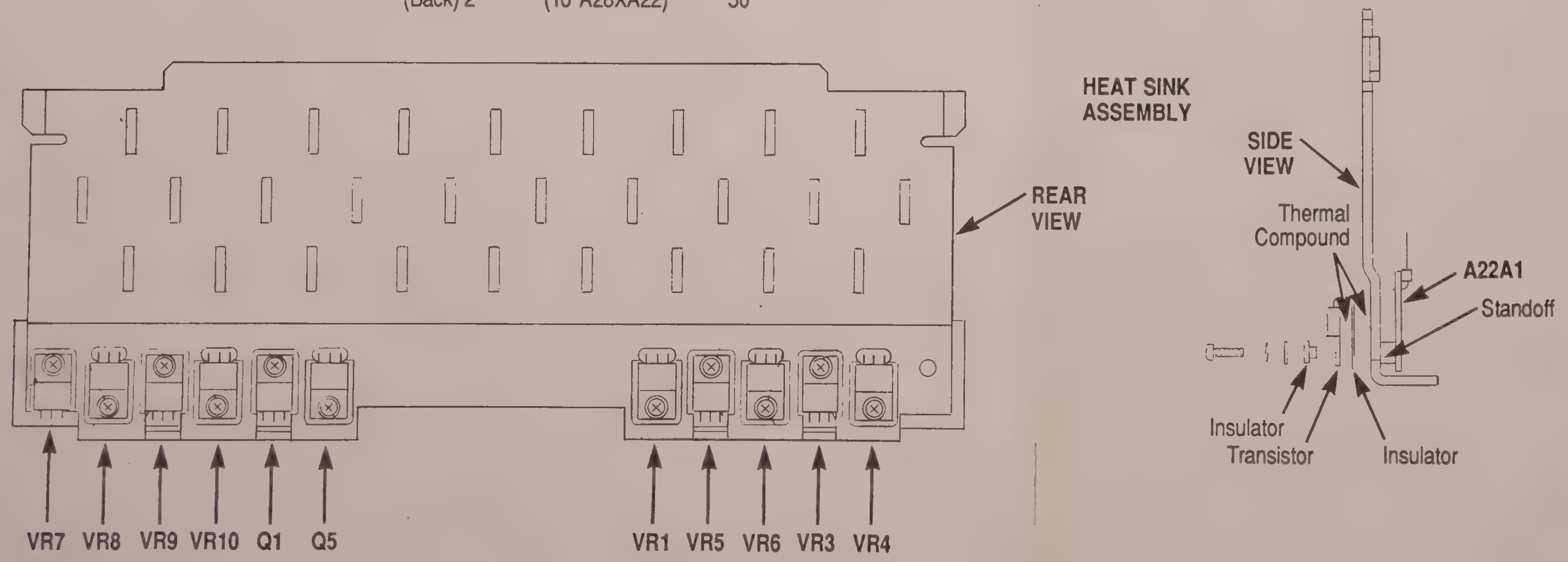
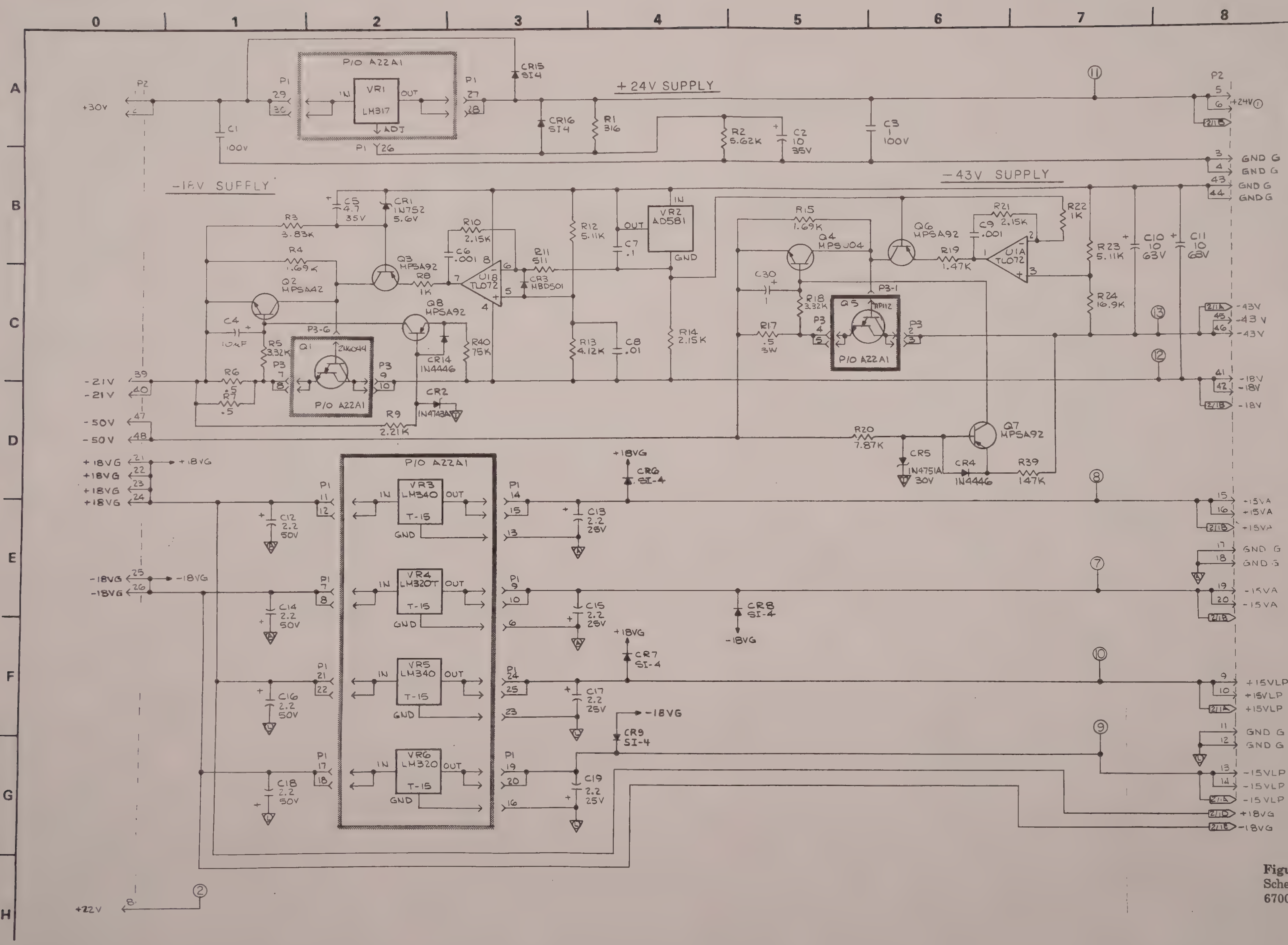

HEAT SINK
ASSEMBLY
REAR
VIEW
VR7
VR8
VR9
VR10
Q1
Q5
VR1
VR5
VR6
VR3
VR4
SIDE
VIEW
Thermal
Compound
A22A1
Standoff
Insulator
Transistor
Insulator

Figure 6N-5. A22 Regulator PCB Parts Locator Diagram
6700-D-31722-3 (Rev. D)

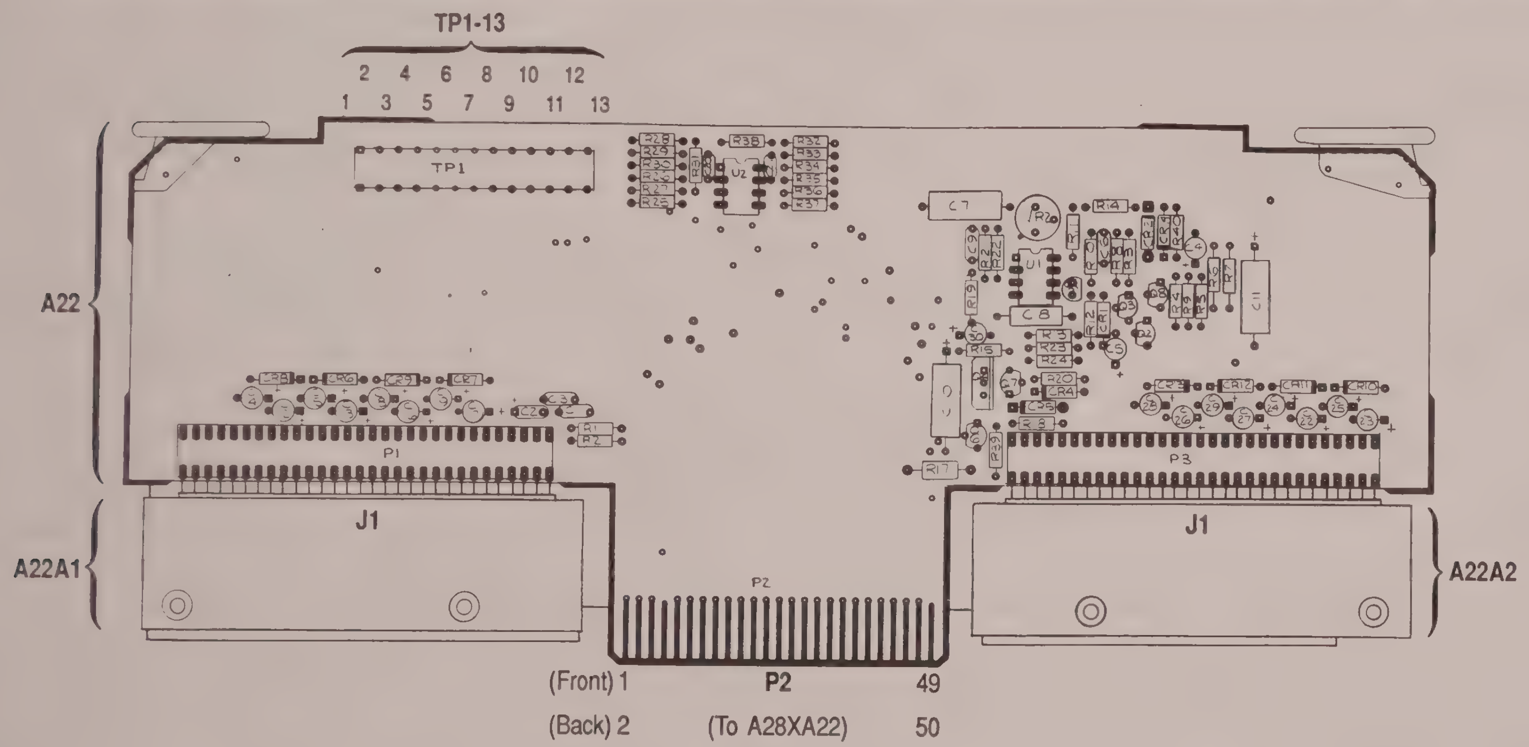

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
+24V SUPPLY
P/O A22A1
VR1
LM317
IN
OUT
ADJ
P1
29
30
27
28
26
P2
+30V
C1
100V
CR15
SI4
CR16
SI4
R1
316
R2
5.62K
C2
10
35V
C3
100V
⑪
5
6
+24V①
2/1B
3
4
GND G
GND G
-18V SUPPLY
-43V SUPPLY
43
44
GND G
GND G
C5
4.7
35V
CR1
1N752
5.6V
R3
3.83K
R4
1.69K
Q2
MPSA42
Q3
MPSA92
R8
1K
R10
2.15K
C6
.001
U1B
TL072
R11
511
CR3
HBD501
Q8
MPSA92
R12
5.11K
C7
.1
VR2
AD581
OUT
GND
R13
4.12K
C8
.01
R14
2.15K
C4
10μF
R5
3.32K
Q1
2N6044
P3-6
P3
7
8
9
10
R40
75K
CR14
1N4446
CR2
1N4743A
R6
.5
R7
.5
R9
2.21K
-21V
-21V
39
40
-50V
-50V
47
48
R15
1.69K
Q4
MPSU04
Q6
MPSA92
C9
.001
R21
2.15K
R22
1K
R19
1.47K
U1A
TL072
C30
R18
3.32K
Q5
MPS12
P3-1
R17
.5
3W
R23
5.11K
R24
16.9K
C10
10
63V
C11
10
63V
⑬
⑫
2/1A
-43V
45
-43V
46
-43V
41
-18V
42
-18V
2/1B
-18V
R20
7.87K
Q7
MPSA92
CR5
1N4751A
30V
CR4
1N4446
R39
147K
+18VG
+18VG
+18VG
+18VG
21
22
23
24
+18VG
VR3
LM340
T-15
11
12
14
15
13
C12
2.2
50V
C13
2.2
25V
CR6
SI-4
⑧
15
16
-15VA
+15VA
+15VA
17
18
GND G
GND G
-18VG
-18VG
25
26
-18VG
VR4
LM320T
7
8
9
10
6
C14
2.2
50V
C15
2.2
25V
CR8
SI-4
-18VG
⑦
19
20
-15VA
-15VA
VR5
LM340
21
22
24
25
23
C16
2.2
50V
C17
2.2
25V
CR7
SI-4
⑩
9
10
+15VLP
+15VLP
+15VLP
11
12
GND G
GND G
VR6
LM320
17
18
19
20
16
C18
2.2
50V
C19
2.2
25V
-18VG
CR9
SI-4
⑨
13
14
-15VLP
-15VLP
-15VLP
+18VG
-18VG
2/1D
2/1E
+22V
8
②

A22 REGULATOR INTERFACE SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   CHASSIS GROUND:
   ISOLATED GROUNDS: Ⓐ Ⓕ Ⓖ Ⓛ Ⓣ
4. TEST POINTS ARE DENOTED AS: ②
5. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
6. SUBASSEMBLY BORDERS ARE DENOTED AS:
7. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   CR3, U1, U2, VR2
8. LAST USED/NOT USED COMPONENTS ARE:

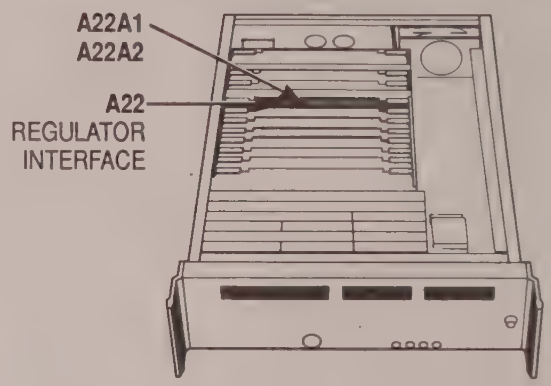
REFERENCE DESIGNATORS	
LAST USED	NOT USED
C30 CR14 Q8 R40 TP13 U2	NONE

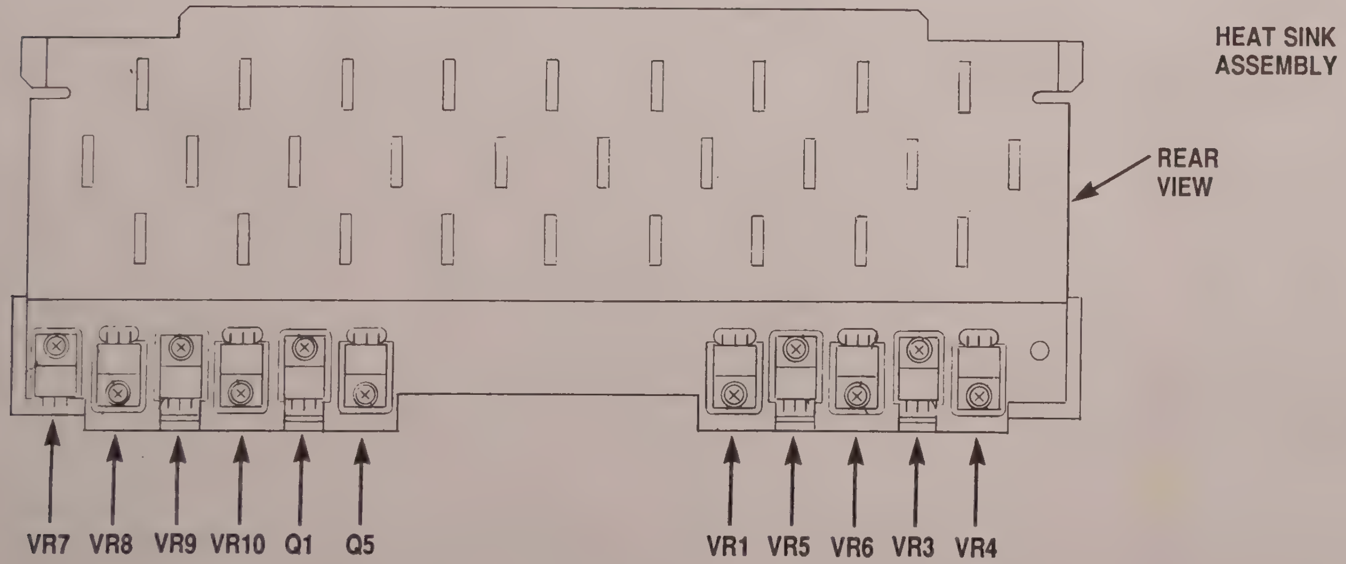
Figure 6N-6. A22 Regulator PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31722-3 (Rev. F)

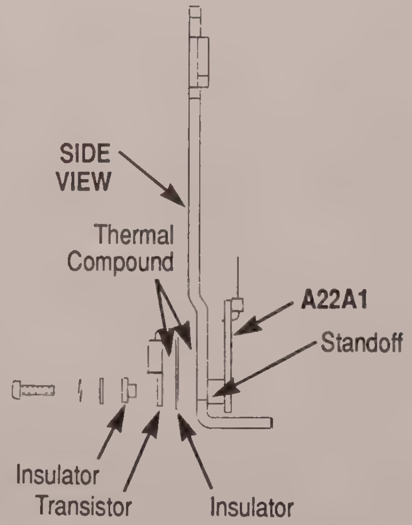

TP1-13
2 4 6 8 10 12
1 3 5 7 9 11 13
TP1
A22
P1
P3
J1
A22A1
J1
A22A2
P2
(Front) 1
P2
49
(Back) 2
(To A28XA22)
50

TEST POINTS	
TP1	GND G
TP2	+22V
TP3	–15VFM
TP4	+15VFM
TP5	–15VG
TP6	+15VG
TP7	–15VA
TP8	+15VA
TP9	–15VLP
TP10	+15VLP
TP11	+24V1
TP12	–18V
TP13	–43V

All measurements are made with reference to GND G at TP1.


A22A1
A22A2
A22
REGULATOR
INTERFACE


HEAT SINK
ASSEMBLY
REAR
VIEW
VR7
VR8
VR9
VR10
Q1
Q5
VR1
VR5
VR6
VR3
VR4


SIDE
VIEW
Thermal
Compound
A22A1
Standoff
Insulator
Transistor
Insulator

Copy of Figure 6N-5. A22 Regulator PCB Parts Locator Diagram 6700-D-31722-3 (Rev. D)

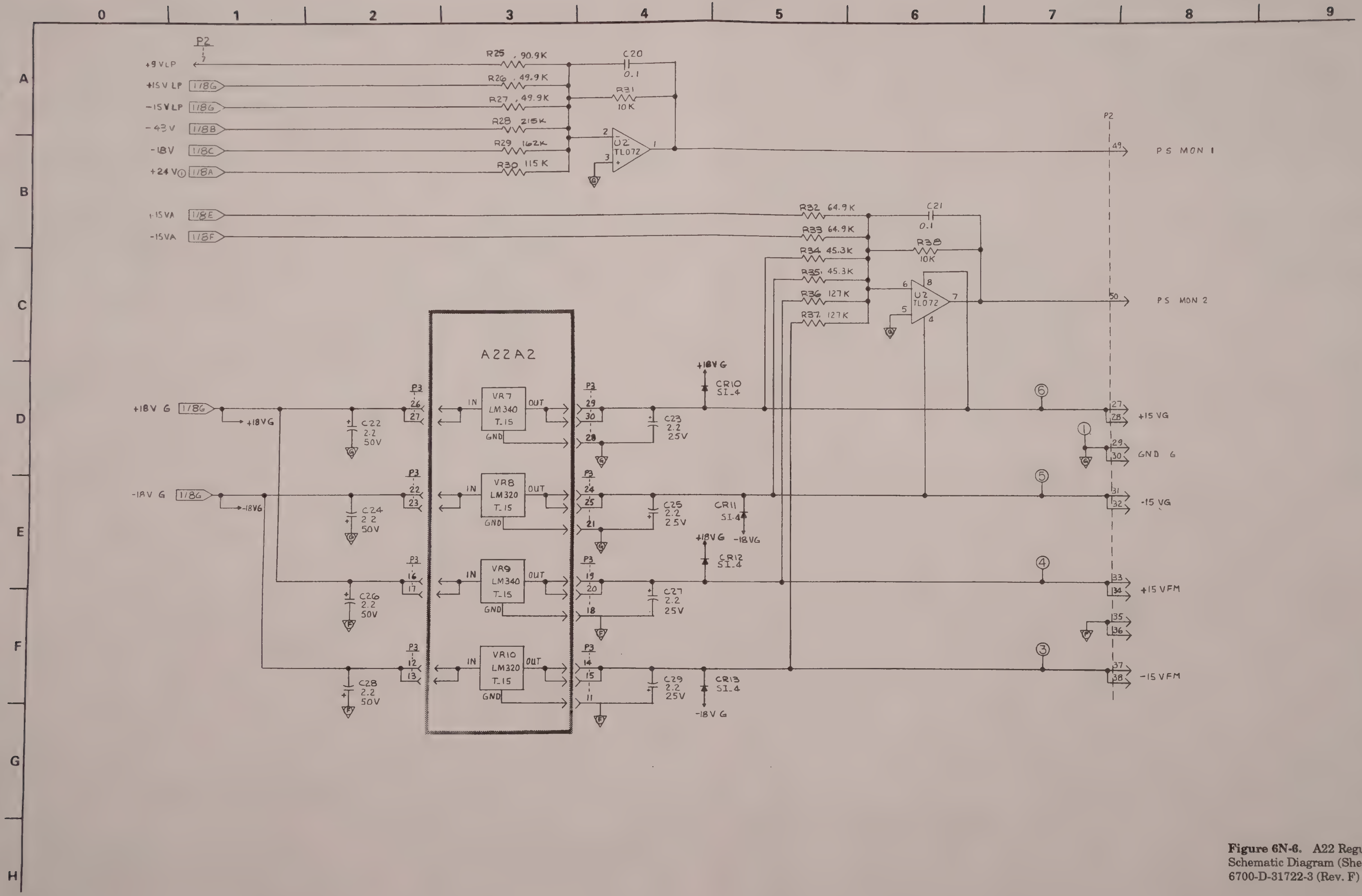
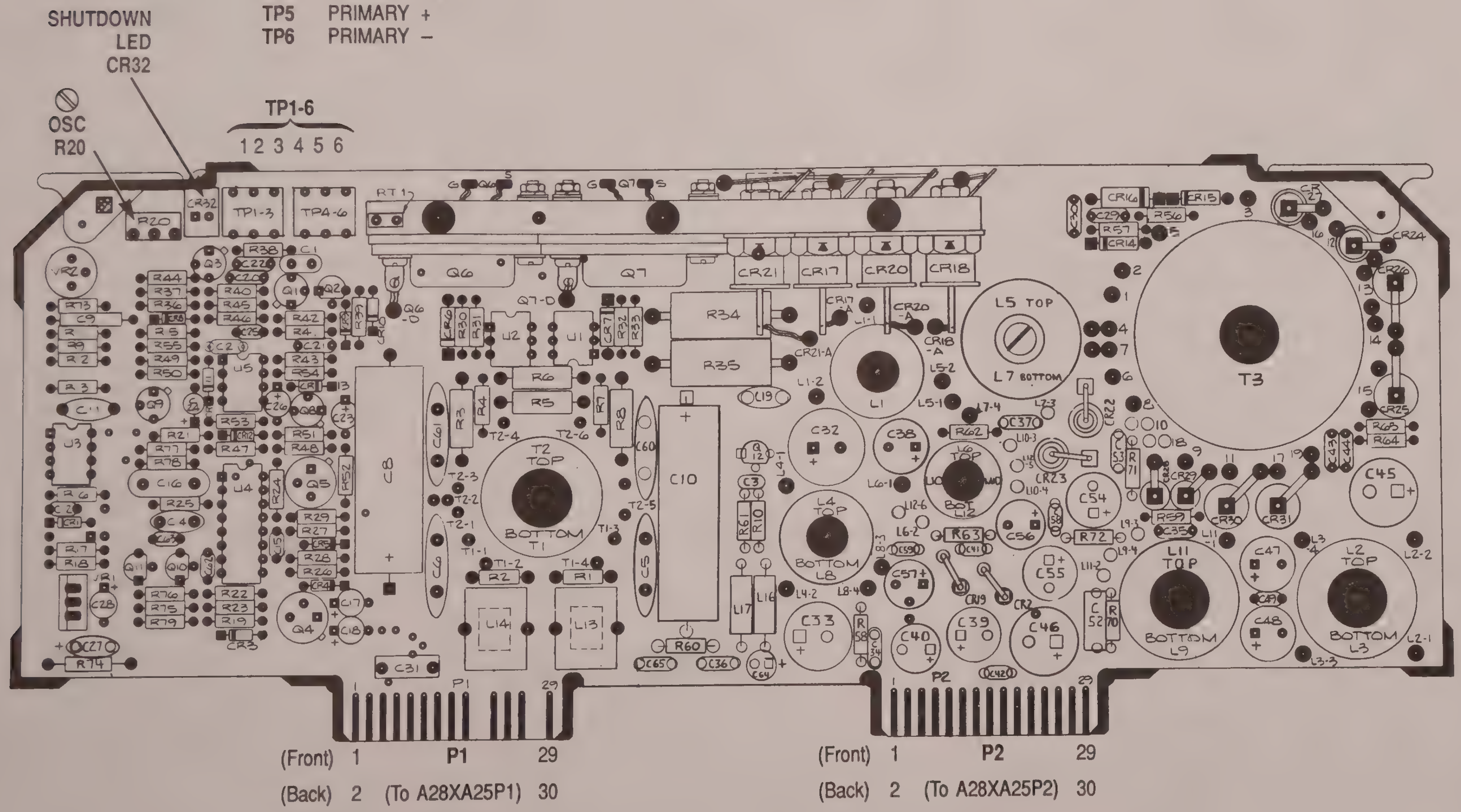

0 1 2 3 4 5 6 7 8 9
A B C D E F G H
P2
+9VLP
+15VLP 1/18G
-15VLP 1/18G
-43V 1/18B
-18V 1/18C
+24V ① 1/18A
R25 90.9K
R26 49.9K
R27 49.9K
R28 215K
R29 162K
R30 115K
C20 0.1
R31 10K
U2 TL072
PS MON 1
49
+15VA 1/18E
-15VA 1/18F
R32 64.9K
R33 64.9K
R34 45.3K
R35 45.3K
R36 127K
R37 127K
C21 0.1
R38 10K
U2 TL072
PS MON 2
50
A22A2
+18V G 1/18G
+18VG
-18V G 1/18G
-18VG
C22 2.2 50V
C24 2.2 50V
C26 2.2 50V
C28 2.2 50V
P3
VR7 LM340 T.15
VR8 LM320 T.15
VR9 LM340 T.15
VR10 LM320 T.15
IN OUT GND
C23 2.2 25V
C25 2.2 25V
C27 2.2 25V
C29 2.2 25V
CR10 SI.4
CR11 SI.4
CR12 SI.4
CR13 SI.4
+18VG
-18VG
-18V G
⑥ ① ⑤ ④ ③
+15 VG
GND G
-15 VG
+15 VFM
-15 VFM

Figure 6N-6. A22 Regulator PCB Schematic Diagram (Sheet 2 of 2)
6700-D-31722-3 (Rev. F)

TEST POINTS

TP1	GND G
TP2	+5VD
TP3	U4 PIN 14 (OSC)
TP4	PRIMARY DRIVE
TP5	PRIMARY +
TP6	PRIMARY –


SHUTDOWN
LED
CR32
OSC
R20
TP1-6
1 2 3 4 5 6
TP1-3
TP4-6
Q6
Q7
CR21
CR17
CR20
CR18
R34
R35
L5 TOP
L7 BOTTOM
T3
T2 TOP
BOTTOM T1
C8
C10
L1
L4 TOP
BOTTOM L8
L6 TOP
BOT L12
L11 TOP
BOTTOM L9
L2 TOP
BOTTOM L3
C45
C33
C39
C40
C46
C55
L14
L13
P1
P2
(Front) 1
P1
29
(Back) 2
(To A28XA25P1)
30
(Front) 1
P2
29
(Back) 2
(To A28XA25P2)
30

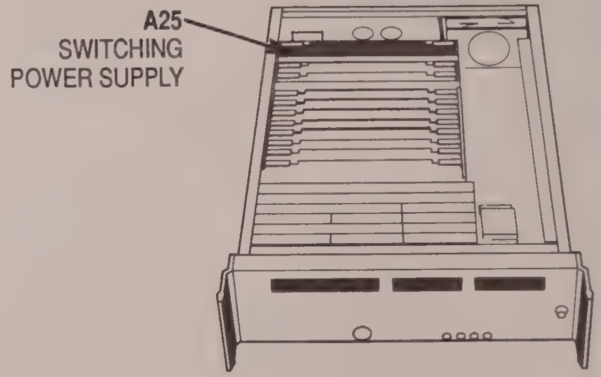
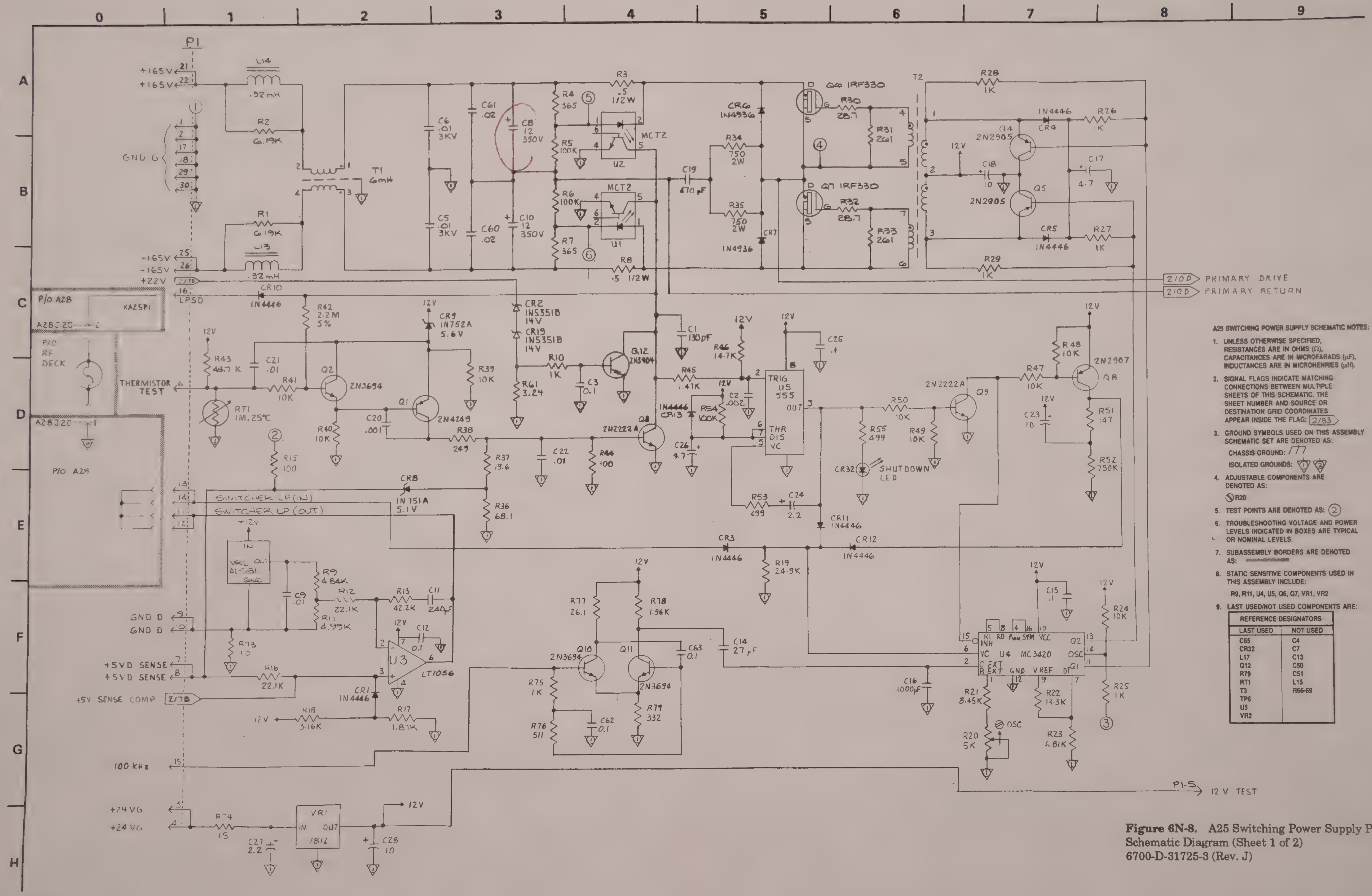

A25
SWITCHING
POWER SUPPLY

Figure 6N-7. A25 Switching Power Supply PCB Parts Locator Diagram
6700-D-31725-3 (Rev. H)



0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
P1
+165V
+165V
-165V
-165V
+22V
2/7B
LPSD
GND G
L14
.32 mH
L13
.32 mH
R2
6.19K
R1
6.19K
T1
6mH
C6
.01
3KV
C5
.01
3KV
C61
.02
C60
.02
C8
12
350V
C10
12
350V
R4
365
R5
100K
R6
100K
R7
365
R3
.5
1/2W
R8
.5 1/2W
MCT2
U2
U1
CR6
1N4936
CR7
1N4936
C19
470 pF
R34
750
2W
R35
750
2W
Q6 IRF330
Q7 IRF330
R30
28.7
R32
28.7
R31
2611
R33
2611
T2
R28
1K
R29
1K
1N4446
CR4
R26
1K
Q4
2N2905
Q5
2N2905
C18
10
C17
4.7
12V
CR5
1N4446
R27
1K
2/10D
PRIMARY DRIVE
2/10D
PRIMARY RETURN
P/O A28
XA25P1
A28J20
P/O RF DECK
THERMISTOR TEST
P/O A28
CR10
1N4446
R42
2.2M
5%
R43
48.7 K
C21
.01
R41
10K
Q2
2N3694
RT1
1M, 25°C
CR9
1N752A
5.6V
Q1
2N4249
R39
10K
R40
10K
C20
.001
R38
249
CR2
1N5351B
14V
CR19
1N5351B
14V
R61
3.24
R10
1K
C3
0.1
Q12
2N3904
C1
130pF
R37
19.6
C22
.01
R44
100
Q3
2N2222A
R36
68.1
R15
100
CR8
1N751A
5.1V
SWITCHER LP (IN)
SWITCHER LP (OUT)
R46
14.7K
R45
1.47K
C2
.002
1N4446
CR13
R54
100K
C26
4.7
U5
555
TRIG
THR
DIS
VC
OUT
C25
.1
R53
499
C24
2.2
R55
499
CR32
SHUTDOWN LED
R50
10K
R49
10K
Q9
2N2222A
R47
10K
R48
10K
Q8
2N2907
R51
147
R52
750K
C23
10
CR11
1N4446
CR3
1N4446
CR12
1N4446
R19
24.9K
+12V
VR2
AD581
IN
OUT
GND
C9
.01
R9
4.84K
R12
22.1K
R11
4.99K
R13
42.2K
C11
240pF
C12
0.1
U3
LT1056
R73
10
GND D
GND D
+5VD SENSE
+5VD SENSE
+5V SENSE COMP
2/7B
R16
22.1K
CR1
1N4446
R18
3.16K
R17
1.87K
R77
26.1
R78
1.96K
Q10
2N3694
Q11
2N3694
C63
0.1
C14
27 pF
R75
1K
R76
511
C62
0.1
R79
332
C15
.1
U4
MC3420
INH
VC
C EXT
R EXT
GND
VREF
DT
OSC
Q1
Q2
VCC
SYM
RO
RI
Pwm
C16
1000pF
R21
8.45K
R22
13.3K
R23
6.81K
R20
5K
OSC
R24
10K
R25
1K
100 KHz
P1-5
12 V TEST
+24VG
+24VG
R74
15
C27
2.2
VR1
7812
IN
OUT
C28
10

A25 SWITCHING POWER SUPPLY SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (µF), INDUCTANCES ARE IN MICROHENRIES (µH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:
   - CHASSIS GROUND: /77
   - ISOLATED GROUNDS: ① ②
4. ADJUSTABLE COMPONENTS ARE DENOTED AS:
   - ⃠R20
5. TEST POINTS ARE DENOTED AS: ②
6. TROUBLESHOOTING VOLTAGE AND POWER LEVELS INDICATED IN BOXES ARE TYPICAL OR NOMINAL LEVELS.
7. SUBASSEMBLY BORDERS ARE DENOTED AS: ▨
8. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:
   - R9, R11, U4, U5, Q6, Q7, VR1, VR2
9. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C65	C4
CR32	C7
L17	C13
Q12	C50
R79	C51
RT1	L15
T3	R66-69
TP6	
U5	
VR2	

Figure 6N-8. A25 Switching Power Supply PCB Schematic Diagram (Sheet 1 of 2)
6700-D-31725-3 (Rev. J)

TEST POINTS

TP1	GND G
TP2	+5VD
TP3	U4 PIN 14 (OSC)
TP4	PRIMARY DRIVE
TP5	PRIMARY +
TP6	PRIMARY −

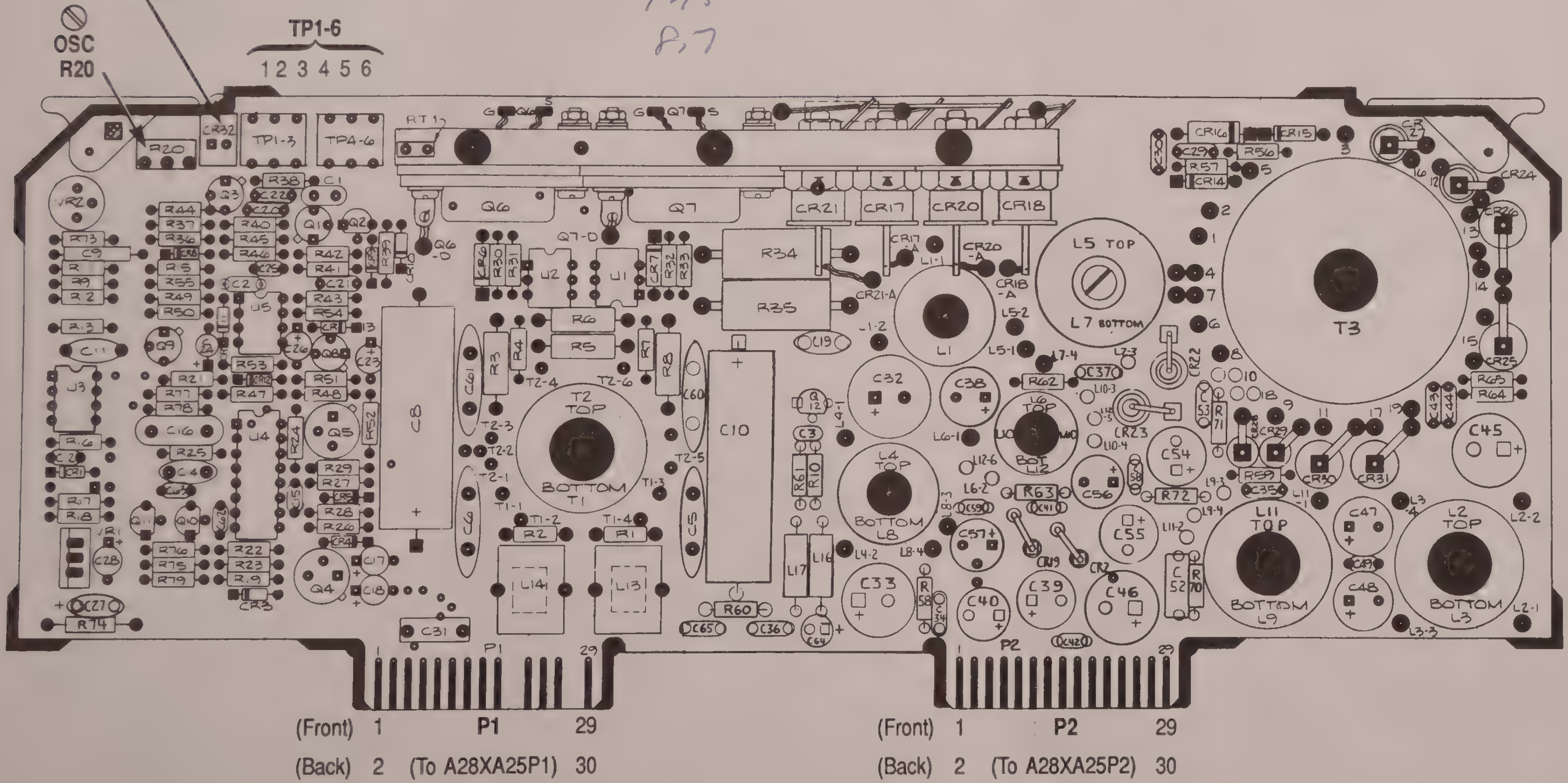
3.7

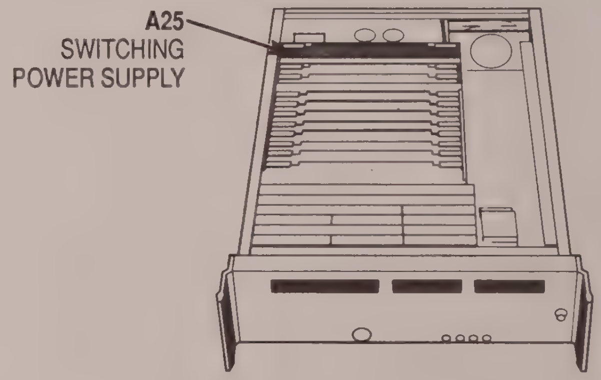
1.4

775

145

8.7


SHUTDOWN
LED
CR32
OSC
R20
TP1-6
1 2 3 4 5 6
TP1-3
TP4-6
Q6
Q7
CR21
CR17
CR20
CR18
R34
R35
U1
U2
U3
U4
U5
C8
C10
T2 TOP
BOTTOM T1
L5 TOP
L7 BOTTOM
L1
T3
L4 TOP
BOTTOM L8
L11 TOP
BOTTOM L9
L2 TOP
BOTTOM L3
L14
L13
C33
C39
C40
C46
C45
(Front) 1 P1 29
(Back) 2 (To A28XA25P1) 30
(Front) 1 P2 29
(Back) 2 (To A28XA25P2) 30


A25
SWITCHING
POWER SUPPLY

Copy of Figure 6N-7. A25 Switching Power Supply PCB Parts Locator Diagram
6700-D-31725-3 (Rev. H)

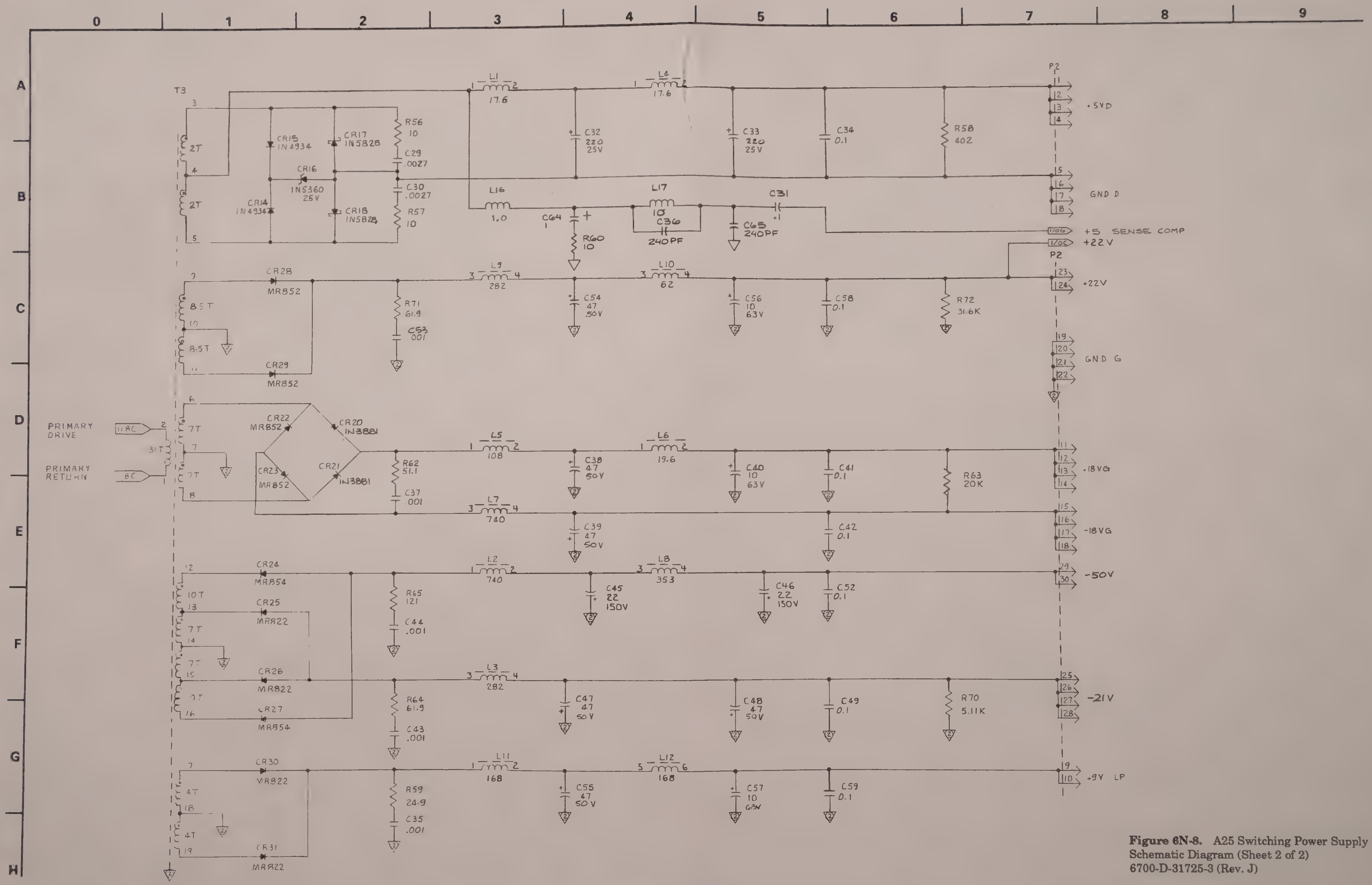
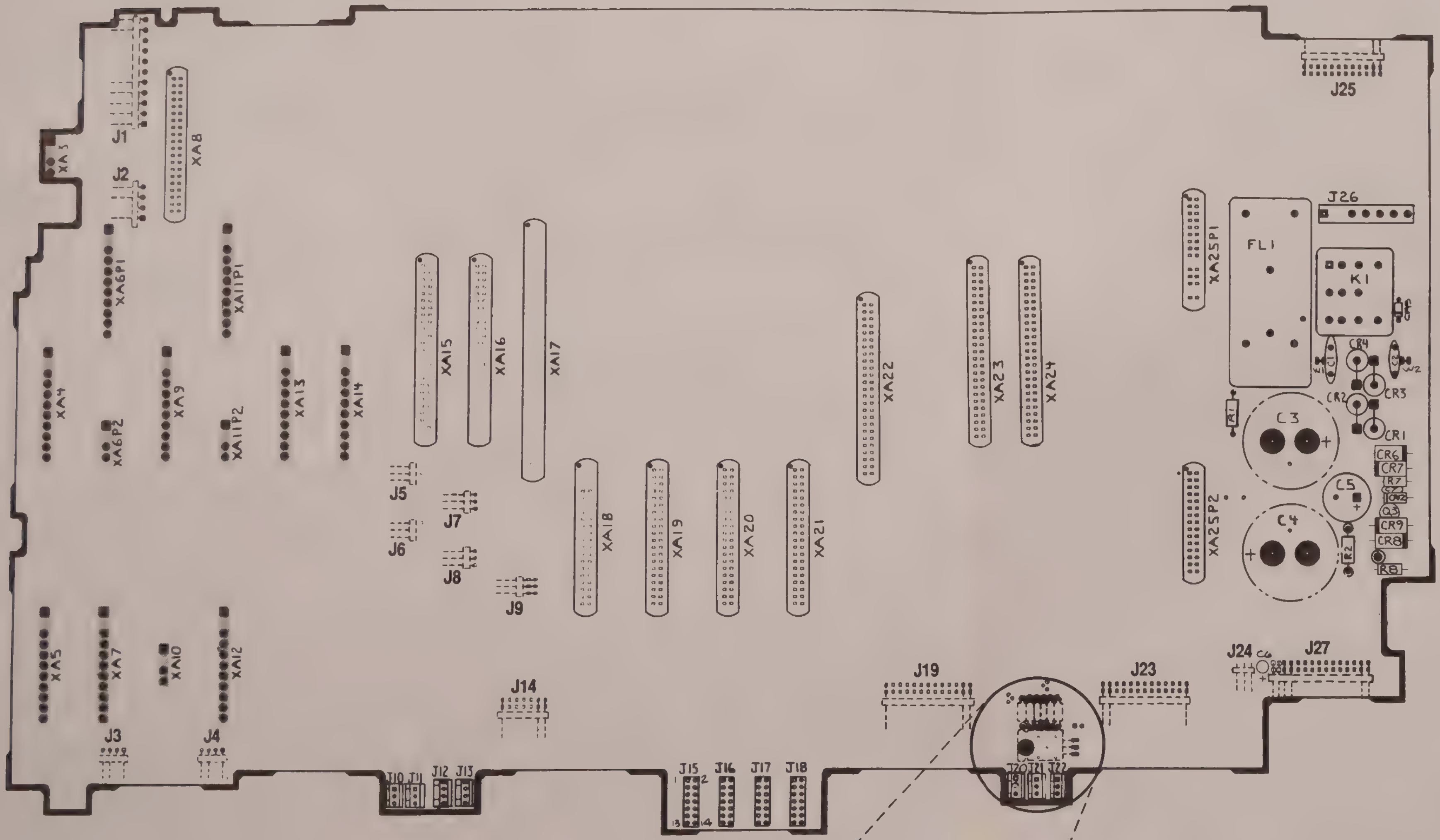
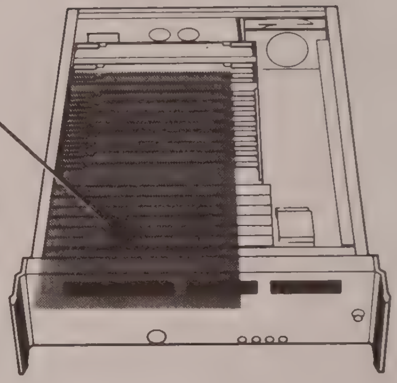

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
T3
2T
2T
8.5T
8.5T
7T
7T
31T
10T
7T
7T
7T
4T
4T
PRIMARY DRIVE
11BC
PRIMARY RETURN
8C
CR15 IN4934
CR17 IN5828
CR16 IN5360 25V
CR14 IN4934
CR18 IN5828
R56 10
C29 .0027
C30 .0027
R57 10
L1 17.6
L4 17.6
C32 220 25V
C33 220 25V
C34 0.1
R58 402
L16 1.0
L17 10
C36 240PF
C64 1
R60 10
C65 240PF
C31 .1
P2
+5VD
GND D
+5 SENSE COMP
1/06
1/0C
+22V
CR28 MR852
CR29 MR852
R71 61.9
C53 .001
L9 282
L10 62
C54 47 50V
C56 10 63V
C58 0.1
R72 31.6K
GND G
CR22 MR852
CR20 IN3881
CR23 MR852
CR21 IN3881
R62 51.1
C37 .001
L5 108
L6 19.6
C38 47 50V
C40 10 63V
C41 0.1
R63 20K
L7 740
C39 47 50V
C42 0.1
+18VG
-18VG
CR24 MR854
CR25 MR822
CR26 MR822
CR27 MR854
R65 121
C44 .001
L2 740
L8 353
C45 22 150V
C46 22 150V
C52 0.1
-50V
R64 61.9
C43 .001
L3 282
C47 47 50V
C48 47 50V
C49 0.1
R70 5.11K
-21V
CR30 MR822
CR31 MR822
R59 24.9
C35 .001
L11 168
L12 168
C55 47 50V
C57 10 63V
C59 0.1
+9V LP

Figure 6N-8. A25 Switching Power Supply PCB Schematic Diagram (Sheet 2 of 2)
6700-D-31725-3 (Rev. J)

A28 MOTHERBOARD
(As viewed from *top* of instrument)


J25
J1
J2
XA3
XA8
J26
FL1
K1
XA25P1
XA6P1
XA11P1
XA15
XA16
XA17
XA22
XA23
XA24
XA4
XA6P2
XA9
XA11P2
XA13
XA14
C3
CR4
CR3
CR2
CR1
R1
CR6
CR7
R7
C5
Q3
CR9
CR8
R2
R8
C4
XA25P2
J5
J7
J6
J8
J9
XA18
XA19
XA20
XA21
XA5
XA7
XA10
XA12
J3
J4
J14
J19
J23
J24
J27
J10
J11
J12
J13
J15
J16
J17
J18
J20
J21
J22

A28
MOTHERBOARD
(Bottom Side)



NOTES:

1. Filtercons are designated as:
   ●●●●●●●●● ■
   Each signal path connection has (typically) 1500 pF capacitance between it and chassis ground.
2. J1-9, J14, J19, J23-25, and J27 are mounted on the bottom side of the A28 PCB.

Fan Power Supply Components
(As viewed from
bottom of instrument)

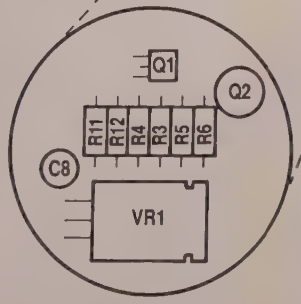
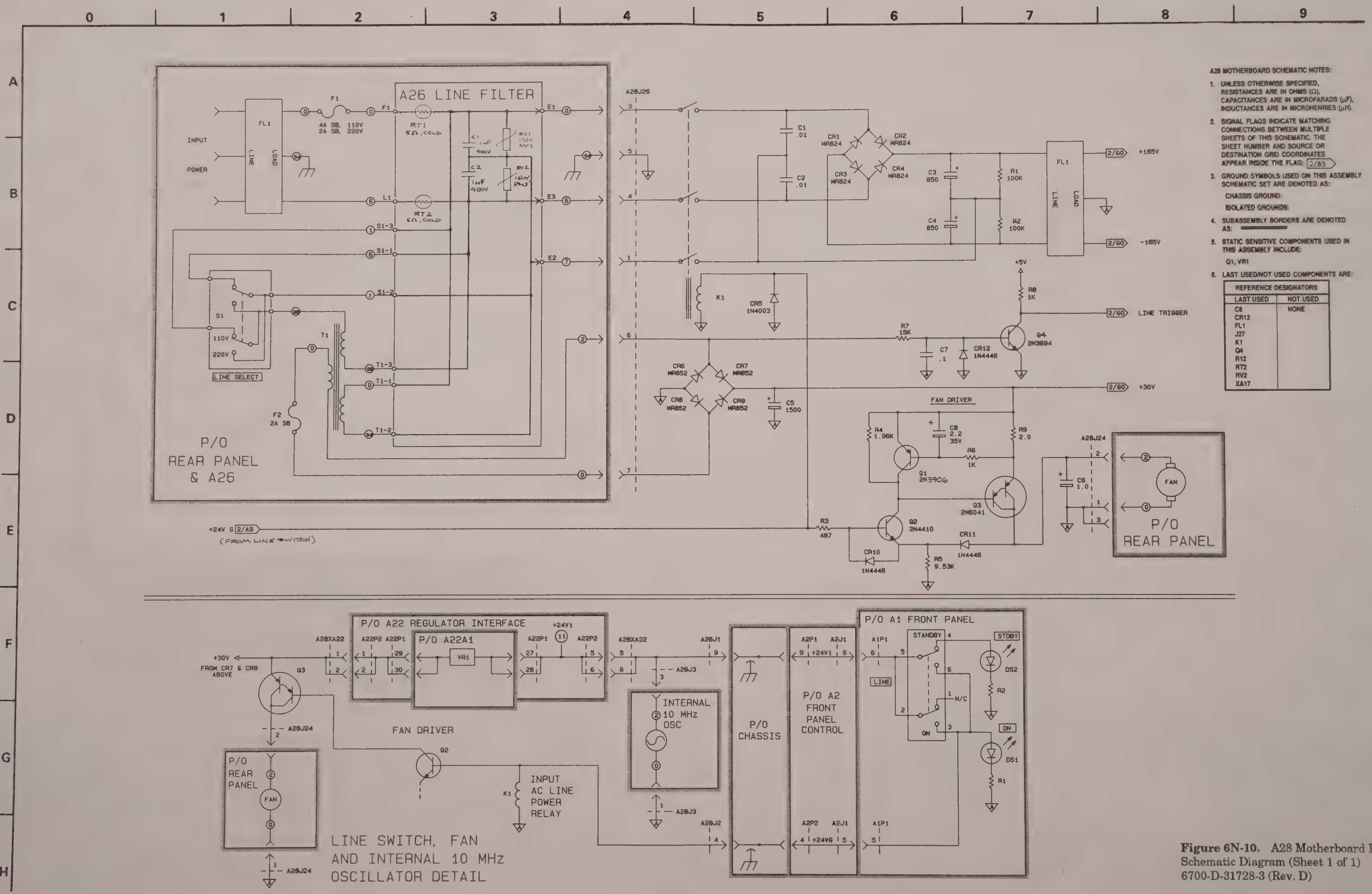

Q1
Q2
R11
R12
R4
R3
R5
R6
C8
VR1

Figure 6N-9. A28 Motherboard PCB Parts Locator Diagram
6700-D-31728-3 (Rev. D)


0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
A26 LINE FILTER
INPUT
POWER
FL1
LINE
LOAD
F1
4A SB. 110V
2A SB. 220V
F1
RT1
5Ω, COLD
C1
1uF
400V
RV1
150V
RMS
C2
1uF
400V
RV2
150V
RMS
L1
RT2
5Ω, COLD
E1
E3
E2
S1-3
S1-1
S1-2
S1
110V
220V
LINE SELECT
T1
T1-3
T1-1
T1-2
F2
2A SB
P/O
REAR PANEL
& A26
A28J26
C1
.01
C2
.01
CR1
MR824
CR2
MR824
CR3
MR824
CR4
MR824
C3
850
C4
850
R1
100K
R2
100K
FL1
LINE
LOAD
2/60
+165V
2/60
-165V
K1
CR5
1N4003
+5V
R8
1K
2/60
LINE TRIGGER
R7
15K
C7
.1
CR12
1N4446
Q4
2N3694
CR6
MR852
CR7
MR852
CR8
MR852
CR9
MR852
C5
1500
2/60
+30V
FAN DRIVER
R4
1.96K
C8
2.2
35V
R9
2.0
R6
1K
Q1
2N3906
Q3
2N6041
A28J24
C6
1.0
FAN
P/O
REAR PANEL
+24V G 2/A9
(FROM LINE SWITCH)
R3
487
Q2
2N4410
CR11
1N4446
CR10
1N4446
R5
9.53K
P/O A22 REGULATOR INTERFACE
P/O A22A1
VR1
+24V1
A28XA22
A22P2
A22P1
A22P1
A22P2
A28XA22
A28J1
+30V
FROM CR7 & CR9
ABOVE
Q3
A28J24
FAN DRIVER
Q2
K1
INPUT
AC LINE
POWER
RELAY
P/O
REAR
PANEL
FAN
A28J24
A28J3
INTERNAL
10 MHz
OSC
A28J3
A28J2
P/O
CHASSIS
P/O A2
FRONT
PANEL
CONTROL
A2P1
A2J1
+24V1
A2P2
A2J1
+24V6
P/O A1 FRONT PANEL
A1P1
STANDBY
STDBY
LINE
N/C
ON
ON
DS2
R2
DS1
R1
A1P1
LINE SWITCH, FAN
AND INTERNAL 10 MHz
OSCILLATOR DETAIL

A28 MOTHERBOARD SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   CHASSIS GROUND:

   ISOLATED GROUNDS:
4. SUBASSEMBLY BORDERS ARE DENOTED AS:
5. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   Q1, VR1
6. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C8 CR12 FL1 J27 K1 Q4 R12 RT2 RV2 XA17	NONE

Figure 6N-10. A28 Motherboard PCB Schematic Diagram (Sheet 1 of 1)
6700-D-31728-3 (Rev. D)

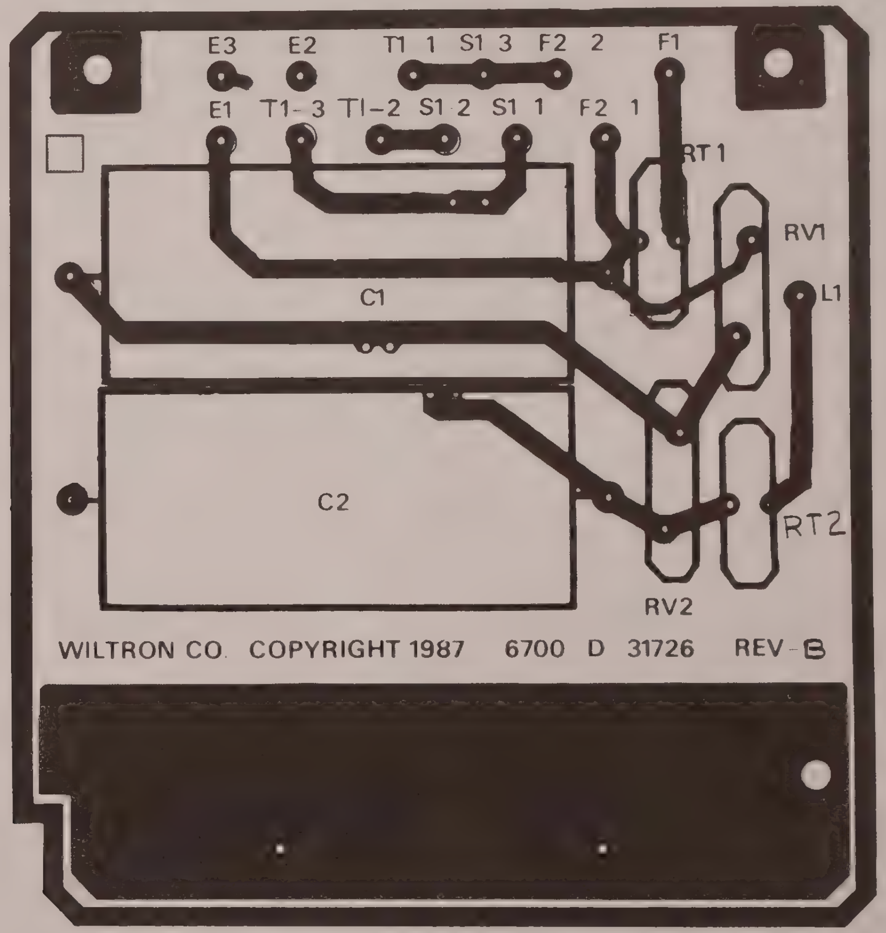

E3
E2
T1 1
S1 3
F2 2
F1
E1
T1-3
T1-2
S1 2
S1 1
F2 1
RT1
RV1
L1
C1
C2
RT2
RV2
WILTRON CO. COPYRIGHT 1987 6700 D 31726 REV-B

Figure 6N-11. A26 Line Filter PCB Parts Locator Diagram 6700-D-31726-3 (Rev. D)

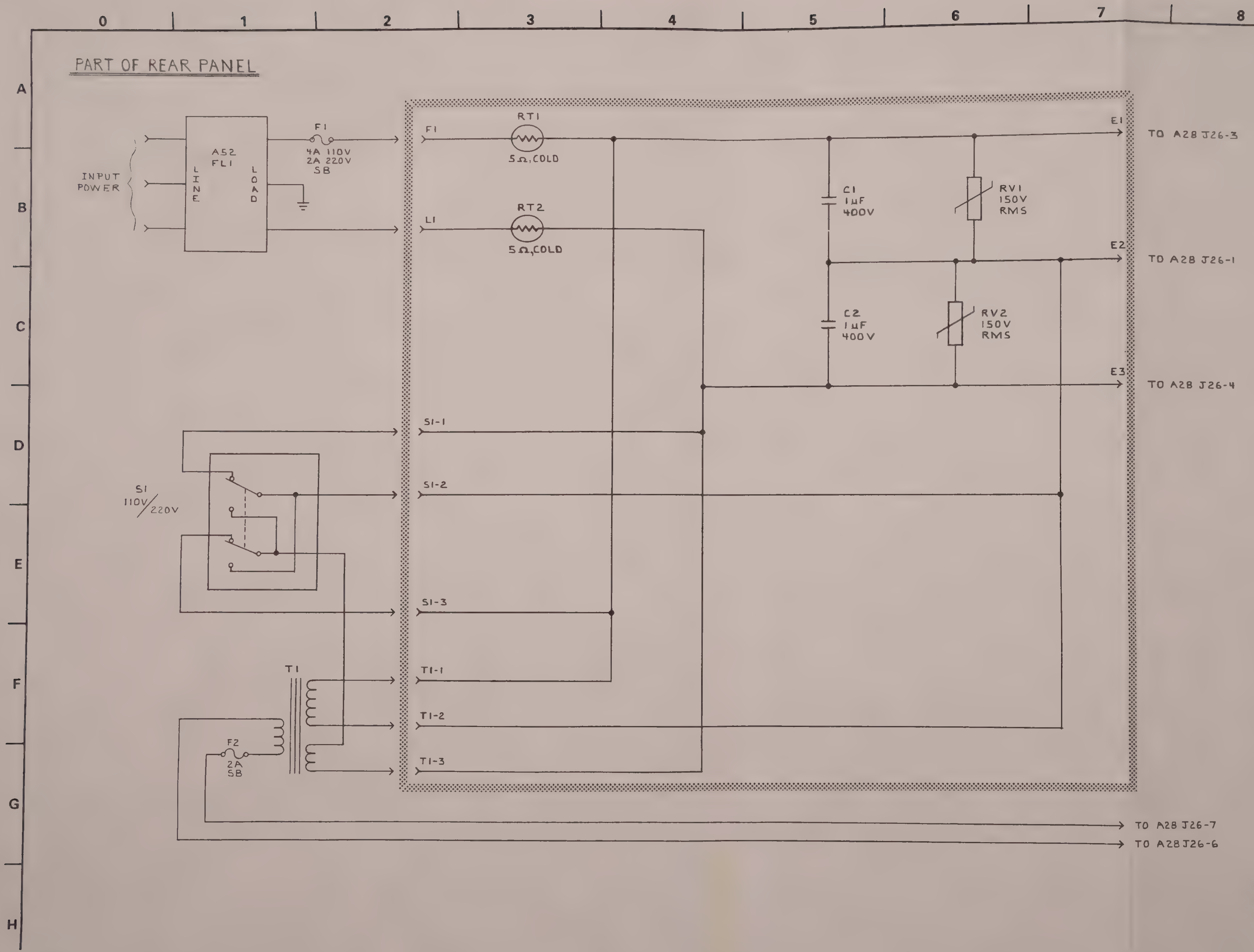

0
1
2
3
4
5
6
7
8
A
B
C
D
E
F
G
H
PART OF REAR PANEL
INPUT POWER
A52 FL1
LINE
LOAD
F1
4A 110V
2A 220V
SB
F1
RT1
5Ω,COLD
L1
RT2
5Ω,COLD
E1
TO A28 J26-3
C1
1µF
400V
RV1
150V
RMS
E2
TO A28 J26-1
C2
1µF
400V
RV2
150V
RMS
E3
TO A28 J26-4
S1
110V/220V
S1-1
S1-2
S1-3
T1
T1-1
T1-2
T1-3
F2
2A
SB
TO A28 J26-7
TO A28 J26-6

Figure 6N-12. A26 Line Filter PCB Schematic Diagram (Sheet 1 of 1) 6700-D-31726-3 (Rev. D)

6P–MOTHERBOARD/INTERCONNECTIONS A28 PCB, INTERCONNECTION CABLES

6P-1 INTRODUCTION

This section contains identification and service information for the inter-assembly RF, control signal and power distribution paths of the synthesizer. Listed in Table 6P-1 (below) is an overview of this section. Refer also to the referenced information in Section 6N—Power Supply and the general reference information in sections 6A, 6B, and 6C.

Table 6P-1. Motherboard/Interconnection Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6P-2	6P-1
Detailed Circuit Description*	Para. 6N-1	6N-1
Block Diagram*	Fig. 6N-4	6N-11
Troubleshooting*	Tbl. 6N-2*	6N-2
* Power Supply Circuits		
PCB LEVEL		
A28 Motherboard PCB:		
Parts Locator Diagram	Fig. 6P-5	6P-6
Connector Cross-Reference	Tbl. 6P-2	6P-8
Schematic	Fig. 6P-6	6P-7
Troubleshooting*	Tbl. 6N-2*	6N-2
* Power Supply Circuits		

6P-2 OVERALL DESCRIPTION

An overall interconnect block diagram for the synthesizer is shown in Figure 6P-2 . Note that the PCBs contained in the synthesizer are located/grouped in the following locations:

- RF Casting.
- Microwave Deck Control PCB card cage (includes A22 Power Regulator),
- Digital PCB enclosure,
- A25 Power Supply PCB enclosure,
- Front Panel,
- Rear Panel.

As shown in Figure 6P-2, the following interconnection methods are used:

- Motherboard Signal Paths,
- Motherboard to PCB via Filtercons,
- Wire Harness and Ribbon Cables,
- Coaxial Cables.

A fifth method—rigid coaxial cable—is used to interconnect the components located on the microwave deck. Refer to Section 6Q.

6P-3 A28 MOTHERBOARD AND CABLE INTERCONNECTS

The following paragraphs describe the functions of the A28 Motherboard and the wire-harness/ribbon cable and coaxial cable interconnects of the synthesizer. The power supply circuits located on the A28 Motherboard are described in detail in Section 6N–Power Supply.

6P-3.1 Motherboard/Interconnect Circuits Description

The A28 Motherboard PCB is an interconnect subsystem that contains connectors and signal pathways that link the various circuit subsystems of the synthesizer. All PCBs are either mounted directly onto the A28 PCB or are cabled to remote connectors on the motherboard. The schematic diagram of the A28 Motherboard, Figure 6P-6 (page 6-9), shows the connectors and signal pathways located on the motherboard. Table 6P-2 (page 6-8), provides location cross-references for all of the connectors shown in Figure 6P-6.

The top schematic diagram of sheet 1 of Figure 6P-6 shows the distribution of the primary ac power from the rear panel via the A26 Line Filter PCB to the A28 Motherboard. As shown, the bridge rectifiers for the +30V, and +165/-165V unregulated dc supplies are located on the Motherboard. Also located on the Motherboard are the LINE switch relay, K1, and the fan driver (switching) circuits for the dc fan. The schematic diagram and parts locator diagram for the A26 Line Filter are located in Section 6N.

WARNING

Voltages hazardous to life are present throughout the Power Supply circuits, *even when the front panel POWER switch is in STANDBY position.*

The ac line voltage and the +24 Vdc are always present whenever the line cord is connected to the ac line voltage source. Use utmost care to avoid electrical shock anytime maintenance procedures are performed.

Other power supply assemblies of the synthesizer include the A22 Regulator Interface PCB and the A25 Switching Power Supply PCB. A detailed description of the operation of the overall power supply subsystem is contained in Section 6N.

The overall block diagram of the power supply circuits of the synthesizer is located in Section 6N (Figure 6N-4). Refer also to the summary diagram located on the bottom of sheet 1 of the A28 PCB schematic diagram (Figure 6P-6). This simplified schematic diagram shows the connection of the +30V unregulated dc to the +24V regulator circuit located on the A22 PCB. It also shows the distribution of the +24V regulated dc to the 10 MHz Reference Oscillator assembly, the LINE-switch, the LINE-switch relay, and the dc fan driver circuits.

6P-3.2 Filtercons

Filtercons are pi-filter circuit elements that are used to connect all control signal and power supply circuit paths from the Motherboard to the A3-A13 PCBs located in the RF Casting and the A1/A2 PCBs mounted on the front panel casting. The locations of the A3-A13 filtercons are shown in Figure 6P-5 (page 6P-6). A typical filtercon application is shown in Figure 6P-1.

6P-3.3 Wiring Harnesses/Ribbon Cables

Figure 6P-3 is an overall diagram of the wire harness and ribbon cable interconnections of the synthesizer. Most of the Microwave Deck control signals are routed from the A15-A21 PCB control circuits via motherboard circuit paths/connectors through wiring harnesses to the components mounted on the Microwave Deck. The remainder of these control signals originate on the A29 Rear Panel Interface PCB and are routed to the Microwave Deck components in a similar manner.

Many of the input/output signals to/from the *front and rear panels* are routed through wiring harnesses and ribbon cables to connectors on the Motherboard and are distributed to the various PCB circuits via Motherboard circuit paths. Most of the signals that interface with the circuits located on the A29 PCB are also routed through the Motherboard via ribbon cables that connect the A29 PCB to the Motherboard.

6P-3.4 RF Casting Coaxial Cables

Figure 6P-4 shows the RF Casting coaxial cable interconnections that distribute RF signals between the various circuit subsystems contained in the RF casting. These cables also distribute rf signals to/from the RF Casting PCBs to the components mounted on the Microwave Deck. Motherboard circuit paths distribute dc power and low frequency control signals to/from these PCBs (via filtercons) as described above.

6P-3.5 Microwave Deck Interconnections

The interconnections of the Microwave Deck components are described in Section 6Q. The parts locator diagram shows the rigid-coax interconnections between the Microwave Deck components. It also shows the various wiring harnesses/coaxial cables that connect these components to the A28/A29 PCBs and the PCBs located in the RF Casting.

6P-4 A28 MOTHERBOARD TROUBLESHOOTING

Refer to Section 6N-Power Supply for information pertaining to troubleshooting of the power Supply circuits located on the A28 Motherboard. Refer also to Section 6C-Troubleshooting.

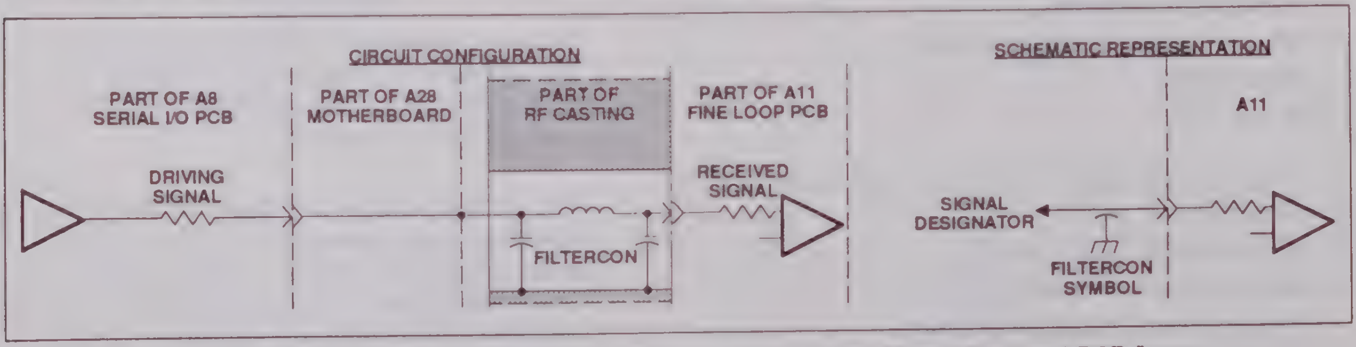


Figure 6P-1. Typical Filtercon Connection Between Motherboard Circuit Path and PCB Input

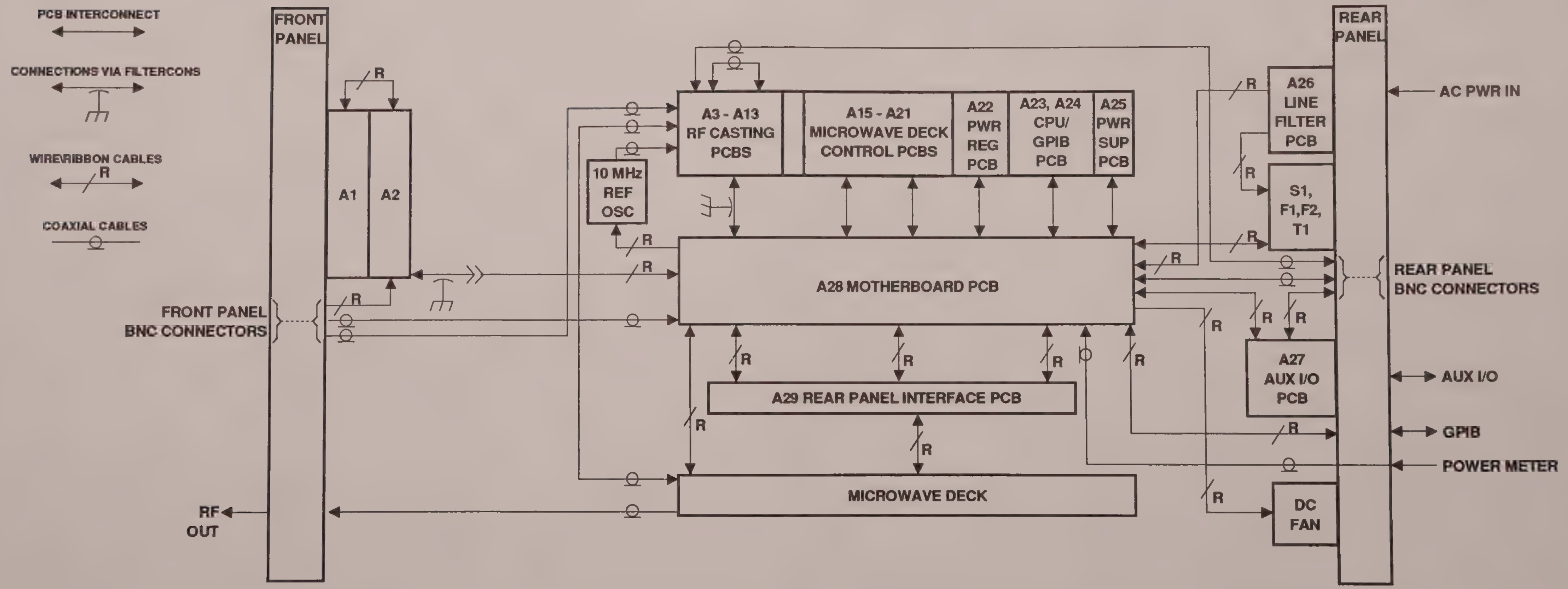
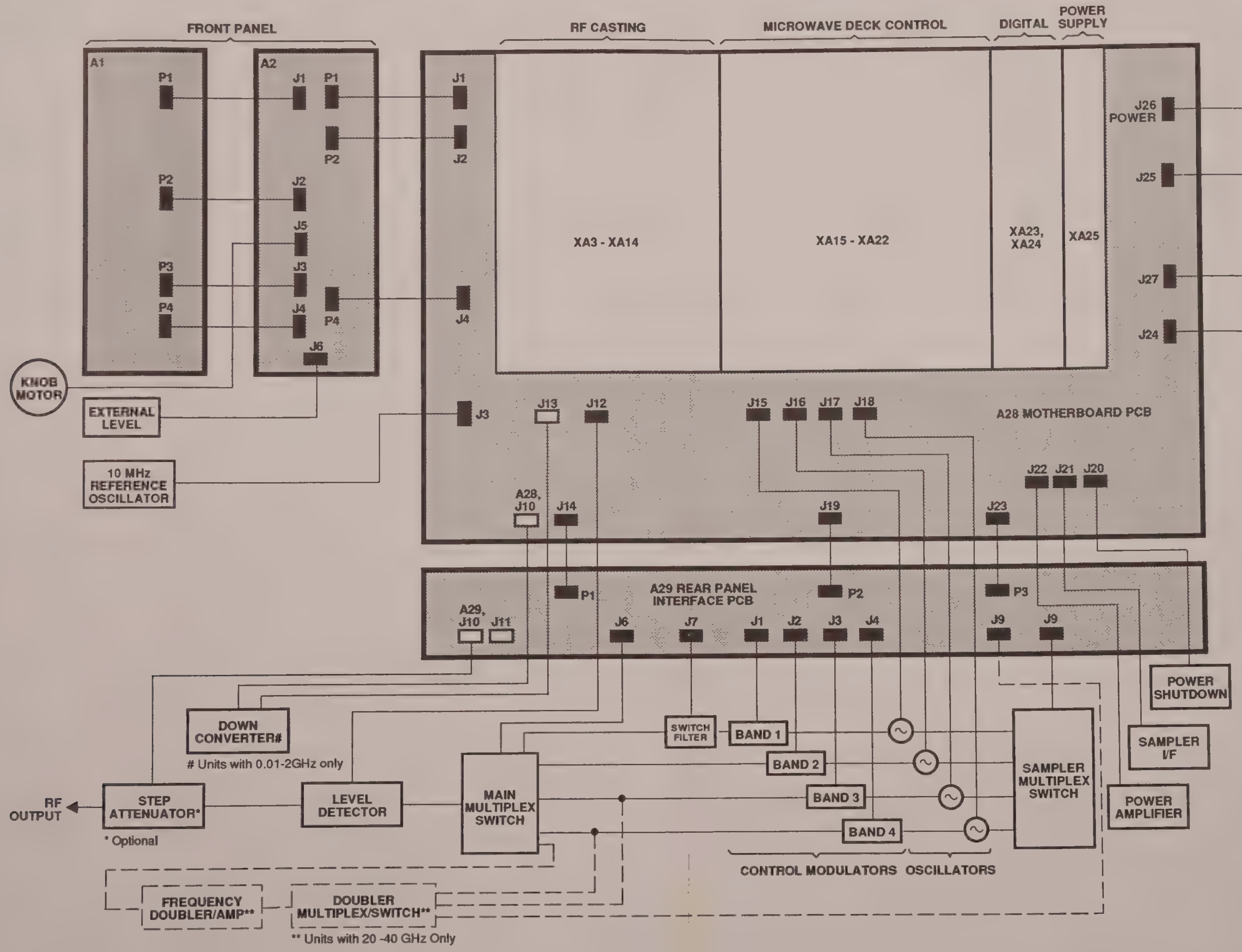

PCB INTERCONNECT
CONNECTIONS VIA FILTERCONS
WIRE\RIBBON CABLES
R
COAXIAL CABLES
FRONT PANEL
REAR PANEL
A1
A2
FRONT PANEL BNC CONNECTORS
RF OUT
10 MHz REF OSC
A3 - A13 RF CASTING PCBS
A15 - A21 MICROWAVE DECK CONTROL PCBS
A22 PWR REG PCB
A23, A24 CPU/ GPIB PCB
A25 PWR SUP PCB
A28 MOTHERBOARD PCB
A29 REAR PANEL INTERFACE PCB
MICROWAVE DECK
A26 LINE FILTER PCB
S1, F1,F2, T1
A27 AUX I/O PCB
DC FAN
AC PWR IN
REAR PANEL BNC CONNECTORS
AUX I/O
GPIB
POWER METER

Figure 6P-2. Conceptual Block Diagram of 67XXA Interconnects


FRONT PANEL
A1
P1
P2
P3
P4
A2
J1
P1
P2
J2
J5
J3
J4
P4
J6
KNOB MOTOR
EXTERNAL LEVEL
10 MHz REFERENCE OSCILLATOR
RF CASTING
MICROWAVE DECK CONTROL
DIGITAL
POWER SUPPLY
J1
J2
J4
J3
XA3 - XA14
XA15 - XA22
XA23, XA24
XA25
J26 POWER
J25
J27
J24
J13
J12
J15
J16
J17
J18
A28 MOTHERBOARD PCB
J22
J21
J20
A28, J10
J14
J19
J23
REAR PANEL
POWER IN
A26
GPIB
A27
FAN
A29 REAR PANEL INTERFACE PCB
P1
P2
P3
A29, J10
J11
J6
J7
J1
J2
J3
J4
J9
J9
POWER SHUTDOWN
SAMPLER I/F
POWER AMPLIFIER
DOWN CONVERTER#
SWITCH FILTER
BAND 1
BAND 2
BAND 3
BAND 4
SAMPLER MULTIPLEX SWITCH
RF OUTPUT
STEP ATTENUATOR*
LEVEL DETECTOR
MAIN MULTIPLEX SWITCH
CONTROL MODULATORS
OSCILLATORS
FREQUENCY DOUBLER/AMP**
DOUBLER MULTIPLEX/SWITCH**

# Units with 0.01-2GHz only

* Optional

** Units with 20 -40 GHz Only

Figure 6P-3. Overall Instrument Wire/Ribbon Cable Interconnect Diagram

NOTE: Refer to table 6A-1 for a cross-reference to PCB assembly functions.

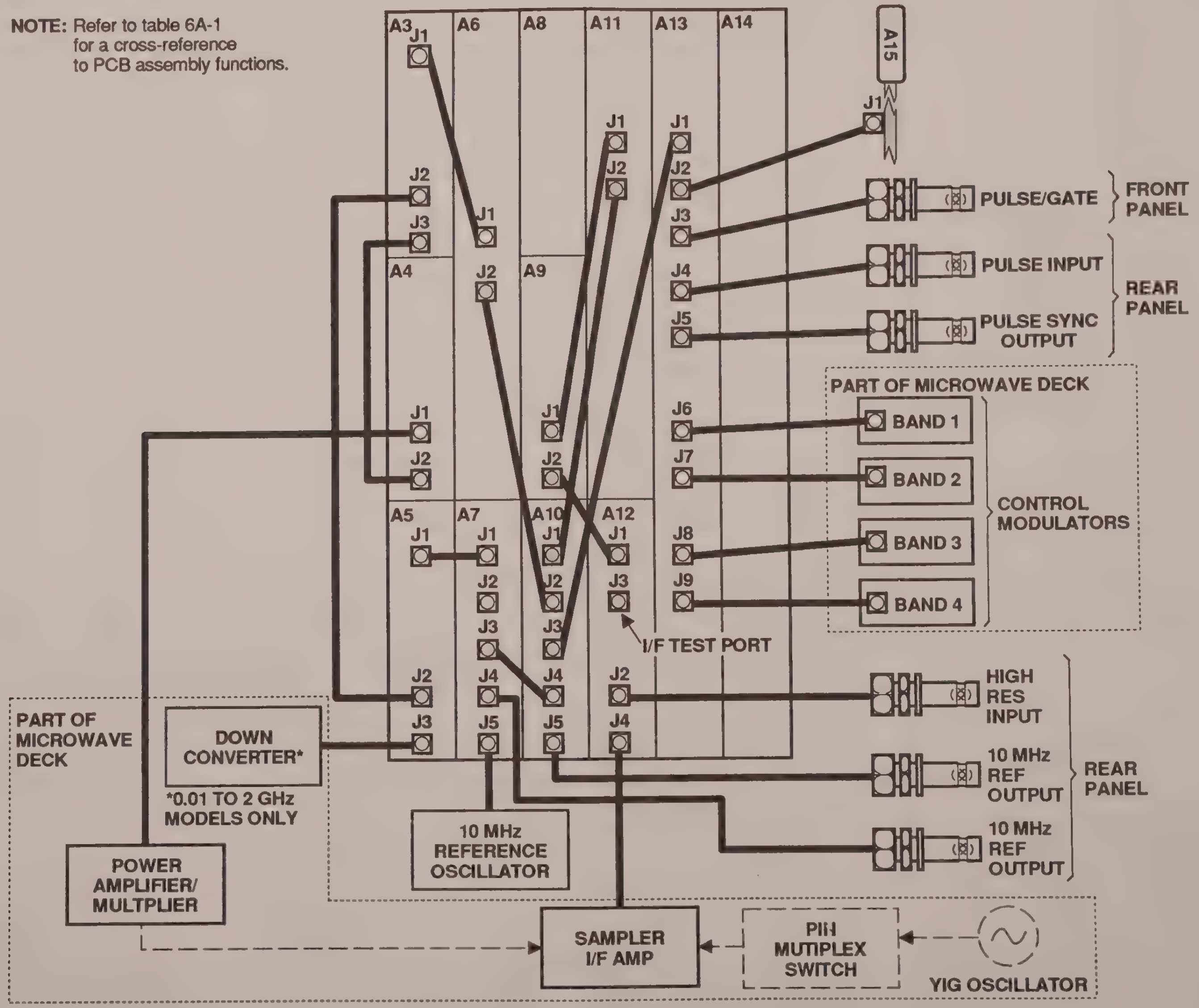
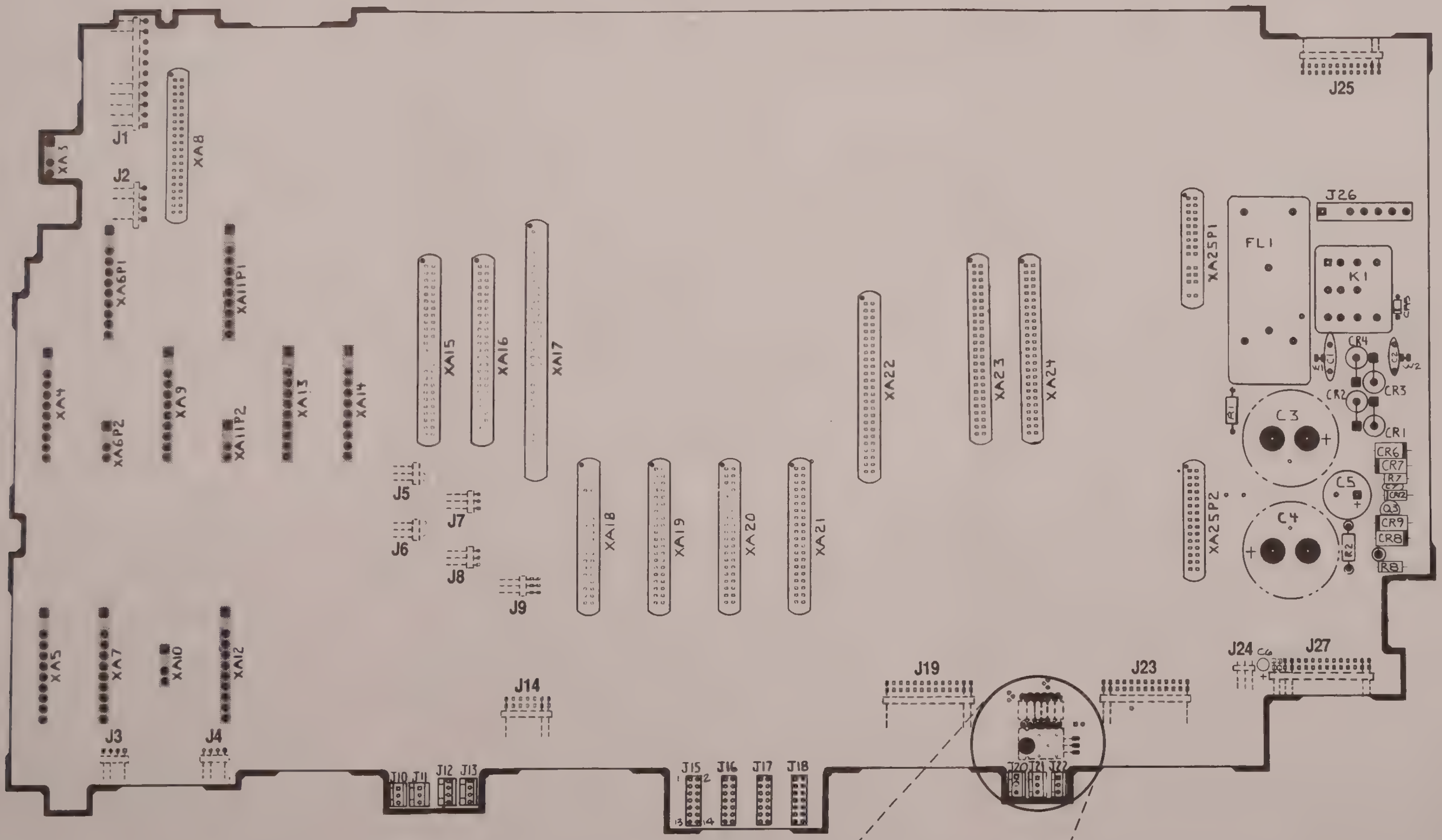
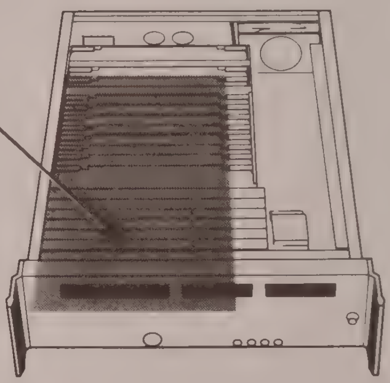

A3
A6
A8
A11
A13
A14
A15
A4
A9
A5
A7
A10
A12
J1
J2
J3
J4
J5
J6
J7
J8
J9
PULSE/GATE
FRONT PANEL
PULSE INPUT
PULSE SYNC OUTPUT
REAR PANEL
PART OF MICROWAVE DECK
BAND 1
BAND 2
BAND 3
BAND 4
CONTROL MODULATORS
I/F TEST PORT
HIGH RES INPUT
10 MHz REF OUTPUT
10 MHz REF OUTPUT
REAR PANEL
PART OF MICROWAVE DECK
DOWN CONVERTER*
*0.01 TO 2 GHz MODELS ONLY
10 MHz REFERENCE OSCILLATOR
POWER AMPLIFIER/ MULTPLIER
SAMPLER I/F AMP
PIN MUTIPLEX SWITCH
YIG OSCILLATOR

Figure 6P-4. RF Casting Coaxial Cable Interconnection Diagram

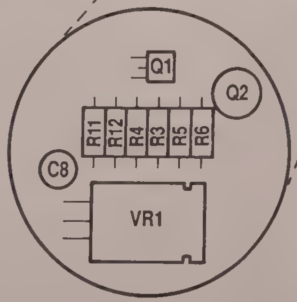
A28 MOTHERBOARD
(As viewed from *top* of instrument)


J1
J2
XA3
XA8
XA6P1
XA11P1
XA4
XA6P2
XA9
XA11P2
XA13
XA14
XA15
XA16
XA17
J5
J6
J7
J8
J9
XA18
XA19
XA20
XA21
XA22
XA23
XA24
XA25P1
XA25P2
J25
J26
FL1
K1
CR4
CR3
CR2
CR1
C1
C2
W2
R1
C3
C4
C5
CR6
CR7
R7
Q3
CR9
CR8
R2
R8
J24
C6
J27
J19
J23
J14
XA5
XA7
XA10
XA12
J3
J4
J10
J11
J12
J13
J15
J16
J17
J18
J20
J21
J22

A28
MOTHERBOARD
(Bottom Side)



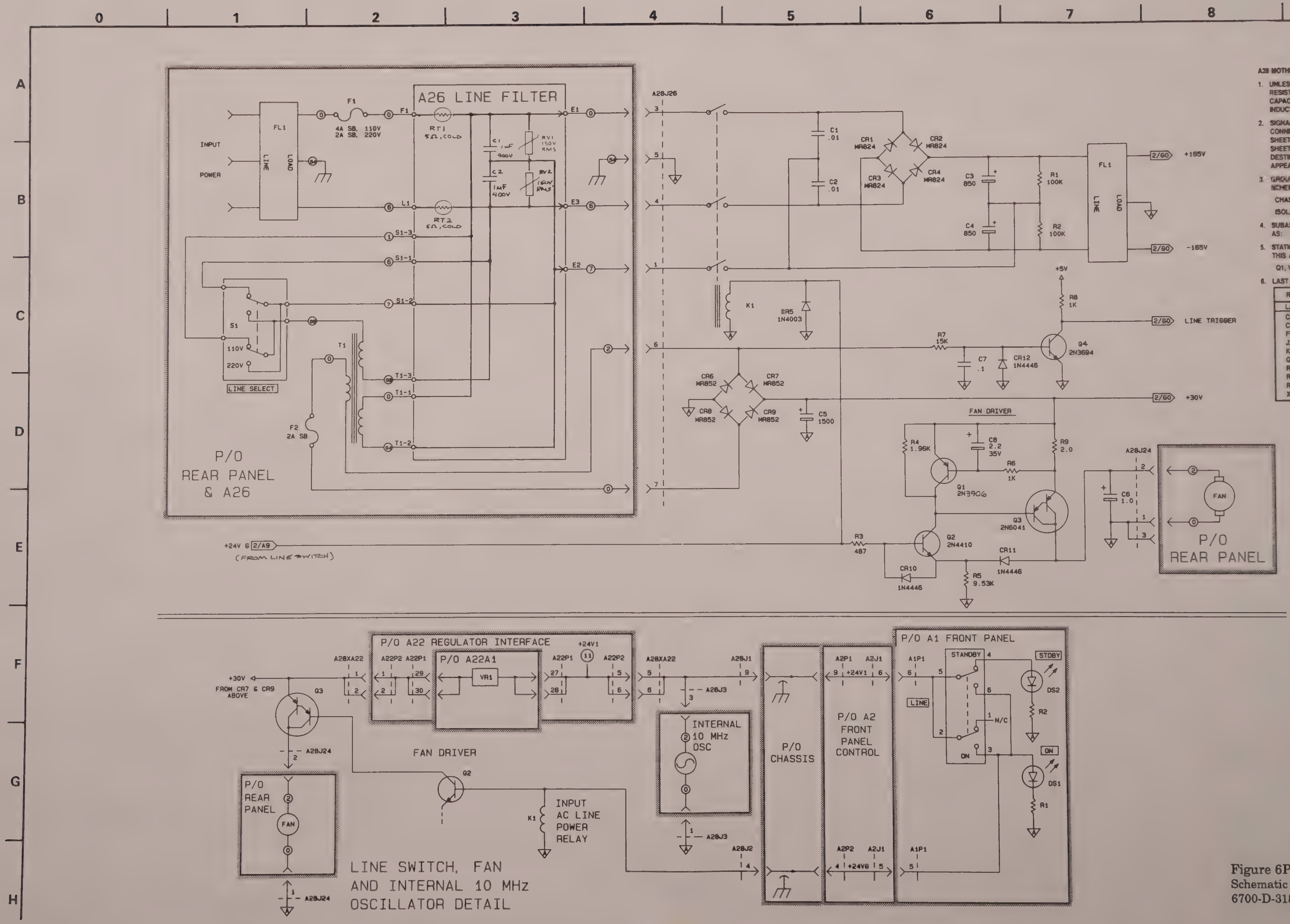
Fan Power
Supply Components
(As viewed from
bottom of instrument)


Q1
Q2
R11
R12
R4
R3
R5
R6
C8
VR1

NOTES:

1. Filtercons are designated as: ●●●●●●●●● ■
   Each signal path connection has (typically) 1500 pF capacitance between it and chassis ground.
2. J1-9, J14, J19, J23-25, and J27 are mounted on the bottom side of the A28 PCB.

Figure 6P-5. A28 Motherboard PCB Parts Locator Diagram
6700-D-31828-3 (Rev. E)



0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
A26 LINE FILTER
INPUT
POWER
FL1
LINE
LOAD
F1
4A SB, 110V
2A SB, 220V
RT1
5Ω, COLD
RT2
5Ω, COLD
C1
1μF
400V
C2
1μF
400V
RV1
150V
RMS
RV2
150V
RMS
E1
E2
E3
L1
S1-3
S1-1
S1-2
S1
110V
220V
LINE SELECT
T1
T1-3
T1-1
T1-2
F2
2A SB
P/O
REAR PANEL
& A26
A28J26
K1
CR5
1N4003
C1
.01
C2
.01
CR1
MR824
CR2
MR824
CR3
MR824
CR4
MR824
C3
850
C4
850
R1
100K
R2
100K
FL1
LINE
LOAD
2/60
+165V
-165V
+5V
R8
1K
LINE TRIGGER
R7
15K
C7
.1
CR12
1N4446
Q4
2N3694
CR6
MR852
CR7
MR852
CR8
MR852
CR9
MR852
C5
1500
+30V
FAN DRIVER
R4
1.96K
C8
2.2
35V
R6
1K
R9
2.0
Q1
2N3906
Q3
2N6041
A28J24
C6
1.0
FAN
P/O
REAR PANEL
+24V
2/A9
(FROM LINE SWITCH)
R3
487
Q2
2N4410
CR11
1N4446
CR10
1N4446
R5
9.53K
P/O A22 REGULATOR INTERFACE
P/O A22A1
VR1
+24V1
A28XA22
A22P2
A22P1
A22P1
A22P2
A28J1
+30V
FROM CR7 & CR9
ABOVE
Q3
A28J24
FAN DRIVER
Q2
P/O
REAR
PANEL
FAN
K1
INPUT
AC LINE
POWER
RELAY
A28J3
INTERNAL
10 MHz
OSC
A28J2
P/O
CHASSIS
A2P1
A2J1
+24V1
P/O A2
FRONT
PANEL
CONTROL
A2P2
A2J1
+24V0
P/O A1 FRONT PANEL
A1P1
STANDBY
STDBY
DS2
R2
LINE
N/C
ON
DS1
R1
LINE SWITCH, FAN
AND INTERNAL 10 MHz
OSCILLATOR DETAIL

A28 MOTHERBOARD SCHEMATIC NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS (Ω), CAPACITANCES ARE IN MICROFARADS (μF), INDUCTANCES ARE IN MICROHENRIES (μH).
2. SIGNAL FLAGS INDICATE MATCHING CONNECTIONS BETWEEN MULTIPLE SHEETS OF THIS SCHEMATIC. THE SHEET NUMBER AND SOURCE OR DESTINATION GRID COORDINATES APPEAR INSIDE THE FLAG: 2/B3
3. GROUND SYMBOLS USED ON THIS ASSEMBLY SCHEMATIC SET ARE DENOTED AS:

   CHASSIS GROUND:

   ISOLATED GROUNDS:
4. SUBASSEMBLY BORDERS ARE DENOTED AS:
5. STATIC SENSITIVE COMPONENTS USED IN THIS ASSEMBLY INCLUDE:

   Q1, VR1
6. LAST USED/NOT USED COMPONENTS ARE:

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C8	NONE
CR12	
FL1	
J27	
K1	
Q4	
R12	
RT2	
RV2	
XA17	

Figure 6P-6. A28 Motherboard PCB Schematic Diagram (Sheet 1 of 2) 6700-D-31828-3 (Rev. B)

Table 6P-2. Connector Location Cross-Reference for A28 Motherboard Schematic Diagram

Connector	Location*	Connector	Location*
A28XA03	A,1	A28J01	B,1
A28XA04	E,1	A28J02	C,1
A28XA05	F,1	A28J03	F,1
A28XA06	C,1	A28J04	D,3
A28XA06,P2	E,1	A28J05	E,3
A28XA07,P1	F,1	A28J06	F,3
A28XA08	B,1	A28J07	D,4
A28XA09	E,4	A28J08	E,4
A28XA10	G,1	A28J09	E,4
A28XA11,P1	D,1	A28J10	G,4
A28XA11,P2	E,2	A28J11	B,8
A28XA12	F,1	A28J12	D,3
A28XA13	D,2	A28J13	E,3
A28XA14	B,2	A28J14	F,3
A28XA15	B,2	A28J15	G,5
A28XA16	B,3	A28J16	G,6
A28XA17	B,4	A28J17	G,6
A28XA18	E,5	A28J18	G,7
A28XA19	E,6	A28J19	B,7
A28XA20	E,6	A28J20	D,8
A28XA21	E,7	A28J21	B,8
A28XA22	E,8	A28J22	C,8
A28XA23	B,6	A28J23	C,7
A28XA24	B,6	A28J24	D,7 (Sheet 1 of schematic)
A28XA25,P1	D,8	A28J25	B,7
A28XA25,P2	E,8	A28J26	A,4 (Sheet 1 of schematic)
		A28J27	C,8

* Sheet 2 of schematic, unless otherwise noted.

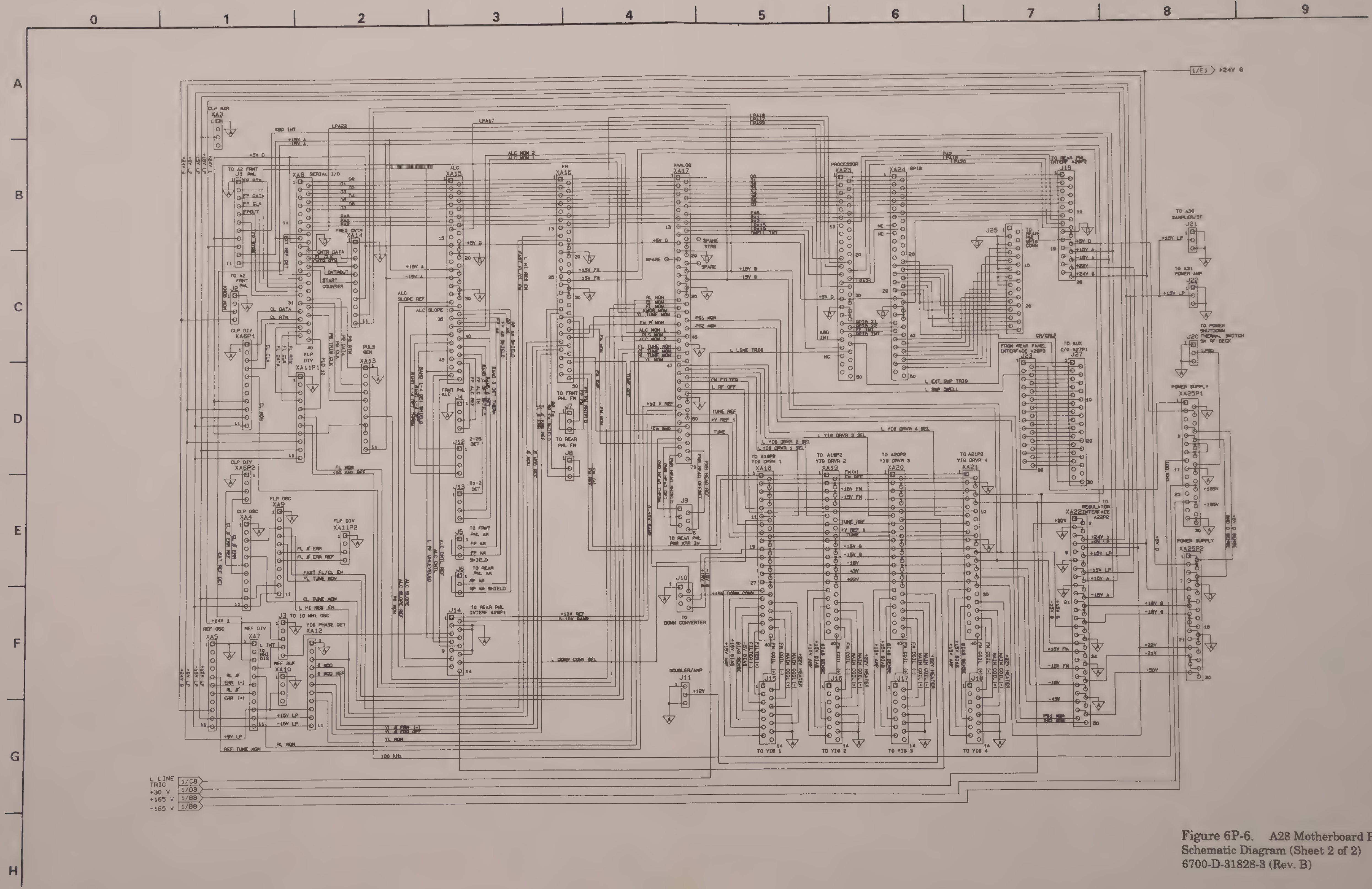

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
1/E1
+24V 6
CLP MXR XA3
TO A2 FRNT PNL J1
TO A2 FRNT PNL J2
XA8 SERIAL I/O
FREQ CNTR XA14
CLP DIV XA6P1
FLP DIV XA11P1
PULS GEN XA13
ALC XA15
FM XA16
ANALOG XA17
PROCESSOR XA23
XA24 GPIB
TO REAR PNL INTERF A29P2 J19
J25
TO A30 SAMPLER/IF J21
TO A31 POWER AMP J22
TO POWER SHUTDOWN THERMAL SWITCH ON RF DECK J20
FROM REAR PANEL INTERFACE A29P3 J23
TO AUX I/O A27P1 J27
POWER SUPPLY XA25P1
POWER SUPPLY XA25P2
TO REGULATOR INTERFACE A22P2 XA22
TO A18P2 YIG DRVR 1 XA18
TO A19P2 YIG DRVR 2 XA19
TO A20P2 YIG DRVR 3 XA20
TO A21P2 YIG DRVR 4 XA21
J15 TO YIG 1
J16 TO YIG 2
J17 TO YIG 3
J18 TO YIG 4
CLP DIV XA6P2
CLP OSC XA4
FLP OSC XA9
FLP DIV XA11P2
REF OSC XA5
REF DIV XA7
J3 TO 10 MHz OSC
YIG PHASE DET XA12
REF BUF XA10
FRNT PNL ALC J4
J12 2-26 DET
J13 .01-2 DET
J5 TO FRNT PNL AM
J6 TO REAR PNL AM
J14 TO REAR PNL INTERF A29P1
TO FRNT PNL FM J7
TO REAR PNL FM J8
J9 TO REAR PNL PWR MTR IN
J10 TO DOWN CONVERTER
DOUBLER/AMP J11
L LINE TRIG 1/C8
+30 V 1/D8
+165 V 1/B8
-165 V 1/B8

Figure 6P-6. A28 Motherboard PCB Schematic Diagram (Sheet 2 of 2) 6700-D-31828-3 (Rev. B)

6Q–MICROWAVE DECK

6Q-1 RF MICROWAVE DECK ASSEMBLY

This section contains service information for the RF microwave deck assembly and its component frequency bands listed in Table 6Q-1 below. Refer also to the general reference information in Sections 6A, 6B, and 6C.

Reference is made throughout the following description of the RF microwave deck operation to various inputs, outputs, and loops involving related circuits and PCBs. You may wish to refer to other sections of this manual for more detail as follows:

- Section 6G–Reference Loop
- Section 6H–Coarse Loop
- Section 6I–Fine Loop
- Section 6J–YIG Loop/FM Subsystem
- Section 6K–Analog Instruction
- Section 6M –Automatic Level Control/ Pulse Modulation

Table 6Q-1. Microwave Deck Service Information

Documentation	Reference	Page
OVERALL ASSEMBLY LEVEL		
Overall Description	Para. 6Q-2	6Q-1
Block Diagram	Fig. 6Q-1	6Q-9
Troubleshooting	Tbl. 6Q-3	6Q-6
Parts Locator Diagram	Fig. 6Q-2	6Q-10
FREQUENCY BANDS		
Frequency Bands 2 thru 4		
Circuit Description	Para. 6Q-3	6Q-3
Block Diagram	Fig. 6Q-3	6Q-13
Frequency Bands 0 and 1		
Circuit Description	Para. 6Q-4	6Q-4
Block Diagram	Fig. 6Q-4	6Q-14
Frequency Band 5		
Circuit Description	Para. 6Q-5	6Q-5
Block Diagram	Fig. 6Q-5	6Q-15

6Q-2 RF MICROWAVE DECK ASSEMBLY, OVERALL DESCRIPTION

Refer to the block diagram in Figure 6Q-1 for the following description.

The primary purpose of the RF microwave deck assembly is to generate sweep- and CW- frequency RF signals and route these signals to the RF OUTPUT connector. A fully configured microwave deck is capable of generating RF signals in the frequency range of 0.01 to 40 GHz. The frequency range of 0.01 to 40 GHz is divided into 6 distinct frequency bands. They are defined as follows:

- Band 0 – 0.01 to 2 GHz (Heterodyne Band)
- Band 1 – 2 to 8.4 GHz (S/C Band)
- Band 2 – 8 to 12.4 GHz (X Band)
- Band 3 – 12.4 to 20 GHz (Ku Band)
- Band 4 – 18 to 26.5 GHz (K Band)
- Band 5 – 26.5 to 40 GHz (Ka Band)

The configuration of the RF microwave deck varies according to the particular 67XXA model. There are single-band and multi-band models. Table 6Q-2 lists the RF microwave deck configuration by model number. Additionally, some models also have a high-power version, so designated by a –10, –20, or –40 after the model number. These models require high-power versions of the standard RF components or the addition of RF amplifiers.

The various models of 67XXA synthesizer produce RF output on bands 0–5 as follows:

- Band 0 (0.01 to 2 GHz) – RF output is produced in this band by downconverting the RF output of the Band 1 YIG-tuned oscillator.
- Bands 1 thru 4 (2 to 26.5 GHz) – RF output is generated in these bands by four YIG-tuned oscillators.
- Band 5 (26.5 to 40 GHz) – RF output is produced in this band by doubling the output of the Band 3 YIG-tuned oscillator.

During the sweep mode in multi-band models, frequency bandswitching occurs at specific switch points. The bandswitch points occur at 2.0 GHz, 8.0 GHz, 12.4 GHz, 18.0 GHz, and 26.5 GHz. At each bandswitch point the YIG-tuned oscillator for the next frequency band to be swept is turned on and phase-locked.

The RF components that are common to all frequency bands and found in all models are described in

Table 6Q-2. RF Microwave Deck Configuration by Model Number

Model Number	Frequency Band(s) Installed					
	Band 0 0.01 to 2 GHz	Band 1 2 to 8.4 GHz	Band 2 8 to 12.4 GHz	Band 3 12.4 to 20 GHz	Band 4 18 to 26.5 GHz	Band 5 26.5 to 40 GHz
6709A/6709A-40	▨					
6717A/6717A-20	▨	▨				
6719A		▨				
6721A/6721A-20		▨	▨			
6722A/6722A-20	▨	▨	▨			
6728A/6728A-40			▨			
6729A/6729A-20			▨	▨		
6730A/6730A-40				▨		
6736A					▨	
6737A/6737A-20		▨	▨	▨		
6740A						▨
6742A					▨	▨
6747A/6747A-20	▨	▨	▨	▨		

the following paragraphs. The RF components that are peculiar to specific frequency bands and/or are found in only some models will be described in later paragraphs as part of the description of that particular frequency band.

Common RF components that make up the RF microwave deck are:

- YIG-tuned Oscillators – The YIG-tuned oscillators generate high-power RF output signals that have low broadband noise and low spurious content. The oscillators are driven by bias voltage and main tuning coil current from the YIG Driver PCBs. The YIG Driver PCBs develop this voltage and current from the A17 Analog Instruction PCB's tuning ramp and reference voltage inputs. The main tuning coil current tunes the oscillator to within a few megahertz of the final output frequency. The phase-lock circuitry of the YIG Loop then fine adjusts the oscillator's FM tuning coil current to make the output frequency exact and to reduce FM noise close to the carrier. FM modulation is also obtained by introducing an externally applied control voltage into the oscillator's FM tuning coil control path.
- Isolators – The isolators prevent RF energy from reflecting back into the YIG-tuned oscillators which can cause frequency pulling. They pass forward wave RF energy with only 0.5 to 1 dB of attenuation, however, they attenuate reflected RF energy by 17 to 20 dB. Dual isolators will attenuate reflected RF energy by up to 40 dB.
- Control Modulators – The control modulators provide variable attenuation to control the RF power output of the YIG-tuned oscillators. A portion of the RF input to the modulators is detected prior to modulation and coupled out for use by the YIG Loop phase-lock circuitry. The level modulation driver current input is received from the A29 Rear Panel Interface PCB where it is developed from the ALC control signal. Pulse modulation current is received from the A13 Pulse Generator PCB. The control modulators output modulated RF signals.
- Amplifiers – The RF amplifiers are used to increase the power output of the generated RF frequencies. The average power gain from a typical RF amplifier is 6 dB.
- PIN Switches – the PIN switches are current controlled variable attenuators that switch between available RF signals so that only one RF output signal at a time is coupled to the RF Output or Sampler circuitry. The PIN switches receive their drive current from the A29 PCB's PIN switch drivers. The PIN switches are not installed in single-band units having only one oscillator.

- Filters – The filters provide bandpass filtering of the RF signals to reduce harmonic emissions.
- Directional Couplers – The directional coupler transfers the modulated RF signals to the 67XXA RF OUTPUT. A portion of the RF output is detected and coupled out for use in internal power leveling. The detected RF sample, along with a resistance representing the coupler's temperature, is routed to the A15 ALC PCB.
- Step Attenuators – The optional step attenuators provide up to 110 dB of attenuation for the RF output. Step attenuator drive current is received from the A29 Rear Panel Interface PCB.

6Q-3 FREQUENCY BANDS 2 THRU 4, CIRCUIT DESCRIPTION

Since the RF microwave deck frequency bands 2 (8 to 12.4 GHz), 3 (12.4 to 20 GHz), and 4 (18 to 26.5 GHz) are very similar in operation, the following circuit description will cover all three. Refer to the block diagram in Figure 6Q-3 for the following description.

When operating the 67XXA in the CW or sweep modes, selection of a frequency or a band of frequencies to be swept within the range of 8 to 26.5 GHz will cause the RF microwave deck frequency bands 2, 3, or 4 to generate the requested RF signals as follows.

6Q-3.1 Frequency Control and FM Modulation

The appropriate YIG Driver PCB receives a dc tuning voltage or a tuning ramp sweep voltage along with reference voltage from the A17 Analog Instruction PCB. The YIG driver uses these inputs to produce the bias voltage and main tuning coil current to drive the YIG-tuned oscillator and coarse tune its output frequency to within a few megahertz of the final output frequency.

The YIG-tuned oscillator's output RF signal is sent through an Isolator to the Control Modulator. Before modulation, part of the RF input is detected and coupled out to the Sampler Mux PIN Switch as an input to the YIG phase-lock loop. In the YIG phase-lock loop, the sampled RF is combined with a harmonic frequency derived from the Coarse Loop to produce a YIG IF signal. The YIG IF signal is then compared with a reference frequency derived from the Fine Loop. Any detected phase differences are processed by the FM Driver PCB and sent as input to the YIG driver to fine adjust the YIG-tuned oscillator's FM tuning coil current and obtain an exact frequency output. Additionally, FM modulation of the YIG signal and YIG frequency sweeps of less than 50 MHz are accomplished by summing the appropriate signals into the FM control path of the YIG loop.

6Q-3.2 Power Level Control and AM Modulation

In addition to the RF signal from the YIG-tuned oscillator, the Control Modulator has two other inputs – the ALC input and the pulse input. The ALC input provides driver current to the PIN diodes which control the power level of the RF signals from the YIG-tuned oscillator. This level control modulator driver current is received from the A29 PCB where it is derived from the A15 PCB's ALC control signal input. The PIN diodes controlling the power level act as variable resistors. They have zero ohms resistance at full drive current reflecting all the RF back towards the YIG-tuned oscillator. AM modulation of the RF output signal is accomplished by varying the ALC input driver current with the external modulation signal.

6Q-3.3 Pulse Modulation

The pulse input provides driver current to the PIN diodes which control pulse modulation of the RF output signal. The pulse modulation driver current is received from the A13 Pulse Generator PCB. The PIN diodes controlling pulse modulation act as switches rather than variable resistors – they are either full-on or full-off. The level modulator PIN diodes are isolated from the pulse modulation PIN diodes by a "T" filter consisting of two capacitors and an inductor. This prevents the high-speed video pulses for the pulse modulation PIN diodes from modulating the level control modulator PIN diodes.

6Q-3.4 Output Control

The modulated RF output signal is sent through a Low-Pass Filter to the Main RF Mux PIN Switch. The Low-Pass Filter provides bandpass filtering of the RF signal to reduce harmonic emissions. The Main RF Mux PIN Switch multiplexes the various control modulator outputs into a common output port. Drive current for the switch is received from the PIN switch drivers located on the A29 PCB. The switch input ports supporting frequency bands 2 through 4 (8 to 26.5 GHz) have additional high-pass filtering for the video pulses from the control modulator. The 8 to 12.4 GHz port uses a series PIN diode arrangement to provide minimum harmonic generation at high input power. The 12.4 to 20 GHz and 18 to 26.5 GHz ports have their PIN diodes arranged in a series-shunt configuration. The Main RF Mux PIN Switch is not installed in units having only one oscillator; a separate video filter is installed in these units.

6Q-3.5 Power Level Detection/ALC Loop

The modulated RF signal output from the Main RF Mux PIN Switch is sent to the Directional Coupler for transfer to the 67XXA's RF OUTPUT. A portion of the RF output is detected and coupled out as an input to the ALC loop. The detected RF sample is routed to the A15 ALC PCB. In the ALC loop, the RF sample is compared with a reference voltage that represents the desired RF power output level. If the two voltages do not match, an error correction signal is fed from the A15 PCB to the PIN modulator driver circuit located on the A29 PCB. The resulting modulator driver current to the Control Modulator causes the level control modulator diodes to adjust the RF power level output.

The directional coupler also has a built-in thermistor which outputs a resistance representing the coupler's temperature. This resistance is converted to a voltage by the A15 PCB and monitored by the A17 PCB's DVM circuit. As the ambient temperature changes, the microprocessor compensates for the output level to provide a very stable RF-output-vs-temperature.

6Q-4 FREQUENCY BANDS 0 AND 1, CIRCUIT DESCRIPTION

Since the RF microwave deck frequency band 0 (0.01 to 2 GHz) and band 1 (2 to 8.4 GHz) RF signals are generated using the same YIG-tuned oscillator, the following circuit description will cover both. Refer to the block diagram in Figure 6Q-4 for the following description.

Selecting a frequency or band of frequencies to be swept within the range of frequency band 1 causes the YIG-tuned oscillator to generate 2 to 8.4 GHz RF signals. Selecting a frequency or band of frequencies to be swept within the range of frequency band 0 causes the YIG-tuned oscillator to generate 4.51 to 6.5 GHz RF signals. The 4.51 to 6.5 GHz RF signals are then down converted to produce 0.01 to 2 GHz RF signals.

The YIG-tuned oscillator's output RF signal is sent through a 10 dB Attenuator to the Control Modulator. This control modulator operates the same as the other control modulators; the only difference being that it has an additional RF output for the Down Converter. Refer to paragraphs 6Q-3.1, 6Q-3.2 , and 6Q-3.3 for descriptions of frequency and power level control and AM, FM, and pulse modulation operation.

6Q-4.1 Down Converter

During frequency band 0 operation, the modulated 4.51 to 6.5 GHz RF signal output from the control modulator is sent to the 0.01 to 2 GHz Down Converter. The Down Converter is powered on by the A18 YIG Driver PCB. The other input to the Down Converter is a 500 MHz signal from the Reference Loop. This 500 MHz signal is multiplied (X9) to obtain a 4.5 GHz signal. The modulated 4.51 to 6.5 GHz RF signal is then mixed with the 4.5 GHz signal resulting in a modulated 0.01 to 2 GHz RF signal. The resultant RF signal is sent through a 2 GHz Low-Pass Filter, then amplified and output to the Switched Filter. A portion of the RF output is detected and coupled out as an input to the ALC loop. Refer to paragraph 6Q-3.5 for a description of power level detection and ALC loop operation.

6Q-4.2 Switched Filter

The Switched Filter provides rejection of the harmonics generated by the 2 to 8.4 GHz YIG-tuned oscillator and multiplexing of the 0.01 to 2 GHz RF signal from the Down Converter. Drive current for the switched filter is received from the PIN switch filter drivers located on the A29 PCB.

The modulated 2 to 8.4 GHz RF signal from the control modulator is sent through an RF amplifier to the Switched Filter. The Switched Filter's 2 to 8.4 GHz RF input provides high-pass filtering for the video pulses from the control modulator. The modulated RF signal has three filtering paths; the 3.5 GHz filter path, the 6 GHz filter path, and the 8 GHz filter path (the actual 8 GHz Low-Pass Filter is located external to the switched filter). Since the Down Converter already provides filtering of the 0.01 to 2 GHz RF signal, the signal is multiplexed through to the switched filter output.

6Q-4.3 RF Output

The modulated 0.01 to 8.4 GHz RF signal is sent through a Low-Pass Filter to the Main RF Mux PIN Switch. The Main RF Mux PIN Switch multiplexes the various control modulator outputs into a common output port. Drive current for the switch is provided by the PIN switch drivers located on the A29 PCB. The 0.01 to 8.4 GHz port uses a series PIN diode arrangement to provide minimum harmonic generation at high input power. In the off condition, the port does not draw current and has only a high reverse voltage to turn off the diodes. The Main RF Mux PIN Switch is not installed in units having only one oscillator.

The modulated RF signal output from the Main RF Mux PIN Switch is sent to the Directional Coupler for transfer to the 67XXA's RF OUTPUT. When operating in the frequency range 2 to 8.4 GHz, the portion of the RF output detected and coupled out to the A15 ALC PCB provides an input to the ALC loop. Refer to paragraph 6Q-3.5 for a description of power level detection and ALC loop operation.

6Q-5 FREQUENCY BAND 5, CIRCUIT DESCRIPTION

Frequency band 5 (26.5 to 40 GHz) RF signals are produced by frequency doubling the band 3 (12.4 to 20 GHz) YIG-tuned oscillator's RF signal output. Refer to the block diagram in Figure 6Q-5 for the following description.

Selection of a frequency or band of frequencies to be swept within the frequency range of 26.5 to 40 GHz causes the band 3 YIG-tuned oscillator to generate 13.25 to 20 GHz RF signals. Since the control of the RF frequency and power level and the RF signal modulation is exactly the same as described for frequency band 3 in paragraph 6Q-3, they will not be covered here. The description of the RF signal development will start with the modulated 13.25 to 20 GHz RF signal at the output of the Control Modulator.

6Q-5.1 DPDT PIN Switch

The modulated RF signal is sent through an RF amplifier to the DPDT PIN Switch. The DPDT PIN Switch multiplexes the band 2 (8 to 12.4 GHz) and band 3 (12.4 to 20 GHz) control modulator outputs into two output ports – 8 to 20 GHz port and 13.25 to 20 GHz port. Drive current for the switch is provided by the PIN switch drivers located on the A29 PCB. The modulated 8 to 20 GHz RF signal is sent to the Main RF Mux PIN Switch through a 20 GHz Low-Pass Filter. The modulated 13.25 to 20 GHz RF signal is sent to the Frequency Doubler/Amplifier by way of a 6 dB Attenuator. The DPDT PIN Switch is not installed in units having only one oscillator.

6Q-5.2 Frequency Doubler/Amplifier

During frequency band 5 operation, the modulated 13.25 to 20 GHz RF signal output from the Control Modulator is sent via the DPDT PIN Switch to the Frequency Doubler/Amplifier. The Frequency Doubler/Amplifier is powered on by the A20 YIG Driver PCB. The modulated RF signal is doubled in frequency to 26.5 to 40 GHz. The doubled RF signal is then amplified and sent through a 40 GHz Low-Pass Filter to the Main RF Mux PIN Switch.

6Q-5.3 RF Output

In multi-band units containing frequency band 5, the Main RF Mux PIN Switch's four input ports are as follows; 0.01 to 8 GHz, 8 to 20 GHz, 20 to 26.5 GHz, and 26.5 to 40 GHz. Refer to paragraph 6Q-3.4 for a description of switch operation. The Main RF Mux PIN Switch is not installed in units having only a single oscillator.

The modulated RF signal output from the Main RF Mux PIN Switch is sent to the Directional Coupler for transfer to the 67XXA's RF OUTPUT. As in the other frequency bands, a portion of the RF output is detected and coupled out as input to the ALC loop.

6Q-6 RF MICROWAVE DECK ASSEMBLY, TROUBLESHOOTING

RF microwave deck assembly troubleshooting procedures are covered in Table 6Q-3 (additional ALC circuit troubleshooting can be found in section 6M).

6Q-7 RF MICROWAVE DECK ASSEMBLY, SERVICE SHEETS

Table 6Q-1 on the first page of this section presents the arrangement of the block diagrams and a parts locator diagram for the RF microwave deck assembly and its components.

Table 6Q-3. RF Microwave Deck Troubleshooting (1 of 3)

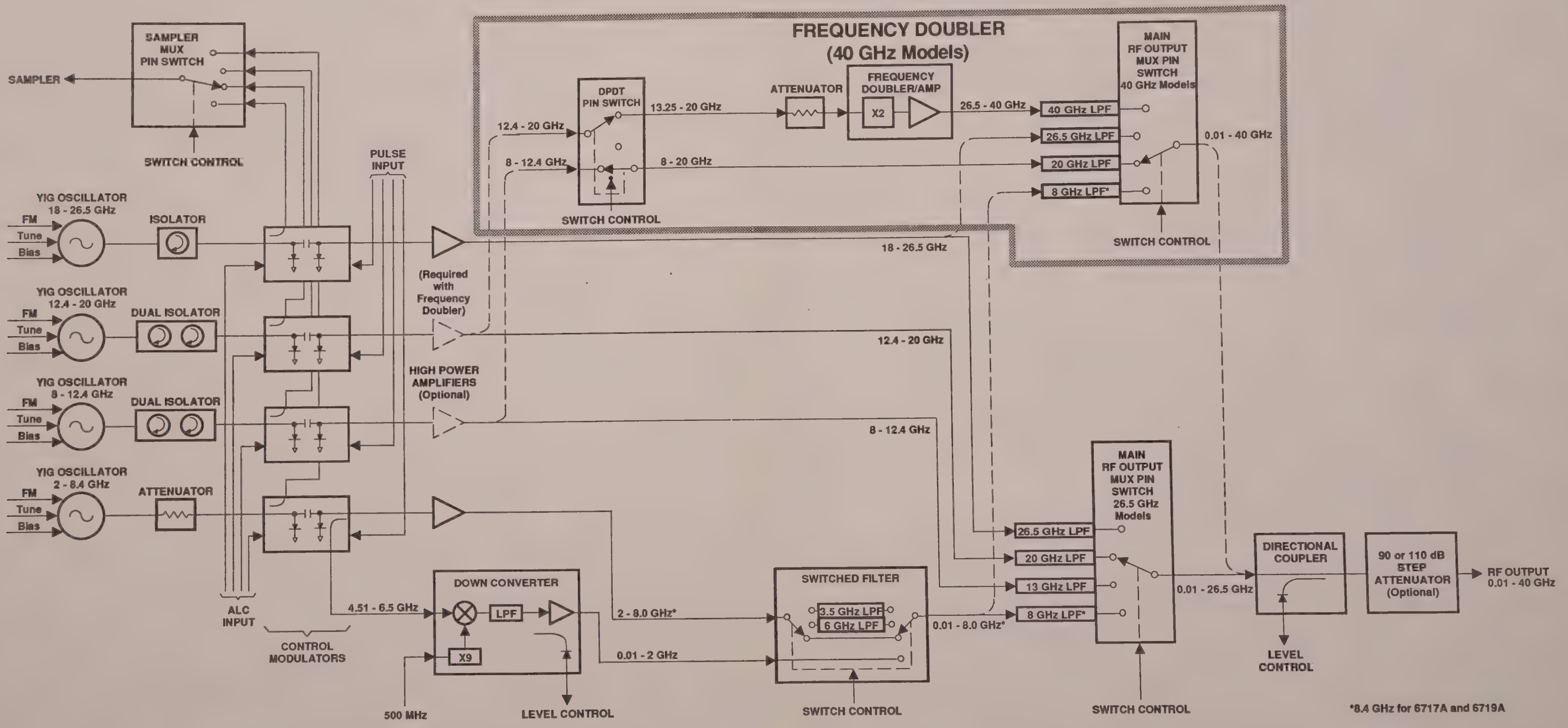
Trouble / Error Code	Troubleshooting Procedure
	NOTE The following error codes and troubleshooting procedures may not be applicable to all 67XXA models because of different RF microwave deck configurations. Table 6Q-2 shows the RF microwave deck configuration by model number. Error Codes – The first two digits of the code indicate the number of the YIG Driver PCB (A18 thru A21) associated with the frequency band. The third digit is the frequency band number. The fourth digit is the type of test.
E18-01 Unleveled Error, Band 0	This error code indicates that the Down Converter RF output is unleveled. The probable cause is either a defective Band 1 (2 to 8.4 GHz) Control Modulator or incorrect/missing level modulation driver current to the Control Modulator. Incorrect/missing modulation driver current can indicate a failure of the A29 PCB Band 1 modulator driver circuit (U42 and U46).
E18-02 No RF Error, Band 0	This error code indicates that frequency band 0 has no RF output. If this is a single-band unit, the probable cause is either a defective A18 YIG Driver PCB, a defective 2 to 8.4 GHz YIG-tuned oscillator, a defective Band 1 Control Modulator, a defective Down Converter, or a missing 500 MHz input to the Down Converter from the A5 Reference Oscillator PCB. If this is a multi-band unit, the probable cause is either a defective Down Converter, a missing 500 MHz input to the Down Converter from the A5 Reference Oscillator PCB, or improper operation of the Switch Filter. Faulty operation of the Switch Filter may be caused by incorrect/missing driver current from the A29 PCB's 0.01 to 2 GHz filter driver circuit (U30A and Q12).
E18-03 FM Path Error, Band 0	This error code indicates that the FM driver circuitry on the A18 YIG Driver PCB is defective.
E18-11 Unleveled Error, Band 1	This error code indicates that the frequency band 1 RF output is unleveled. The probable cause is either a defective Band 1 Control Modulator or incorrect/missing level modulation driver current to the Control Modulator. Incorrect/missing modulation driver current can indicate a failure of the A29 PCB Band 1 modulator driver circuit (U42 and U46).
E18-12 No RF Error, Band 1	This error code indicates that frequency band 1 has no RF output. The probable cause is either a defective A18 YIG Driver PCB, a defective 2 to 8.4 GHz YIG-tuned oscillator, or a defective Band 1 Control Modulator. If this is a multi-band unit, check also for proper operation of the Main RF Mux PIN Switch. Faulty operation of the switch may be caused by incorrect or missing driver current from the A29 PCB's 2 to 8 GHz switch driver circuit (U30B and Q6).
E18-13 FM Path Error, Band 1	This error code indicates that the FM Driver circuitry on the A18 YIG Driver PCB is defective.

Table 6Q-3. RF Microwave Deck Troubleshooting (2 of 3)

Trouble / Error Code	Troubleshooting Procedure
E19-21 Unleveled Error, Band 2	This error code indicates that the frequency band 2 RF output is unleveled. The probable cause is either a defective Band 2 (8 to 12.4 GHz) Control Modulator or incorrect/missing level modulation driver current to the Control Modulator. Incorrect/missing modulation driver current can indicate a failure of the A29 PCB Band 2 modulator driver circuit (U43 and U46).
E19-22 No RF Error, Band 2	This error code indicates that frequency band 2 has no RF output. The probable cause is either a defective A19 YIG Driver PCB, a defective 8 to 12.4 GHz YIG-tuned oscillator, or a defective Band 2 Control Modulator. If this is a multi-band unit, check also for proper operation of the Main RF Mux PIN Switch. Faulty operation of the switch may be caused by incorrect or missing driver current from the A29 PCB's 8 to 12.4 GHz switch driver circuit (U30D and Q5).
E19-23 FM Path Error, Band 2	This error code indicates that the FM Driver circuitry on the A19 YIG Driver PCB is defective.
E20-31 Unleveled Error, Band 3	This error code indicates that the frequency band 3 RF output is unleveled. The probable cause is either a defective Band 3 (12.4 to 20 GHz) Control Modulator or incorrect/missing level modulation driver current to the Control Modulator. Incorrect/missing modulation driver current can indicate a failure of the A29 PCB Band 3 modulator driver circuit (U44 and U46).
E20-32 No RF Error, Band 3	This error code indicates that frequency band 3 has no RF output. The probable cause is either a defective A20 YIG Driver PCB, a defective 12.4 to 20 GHz YIG-tuned oscillator, or a defective Band 3 Control Modulator. If this is a multi-band unit, check also for correct operation of the Main RF Mux PIN Switch. Faulty operation of the switch may be caused by incorrect or missing driver current from the A29 PCB's 12.4 to 20 GHz switch driver circuit (U29D and Q4).
E20-33 FM Path Error, Band 3	This error code indicates that the FM Driver circuitry on the A20 YIG Driver PCB is defective.
E21-41 Unleveled Error, Band 4	This error code indicates that the frequency band 4 RF output is unleveled. The probable cause is either a defective Band 4 (18 to 26.5 GHz) Control Modulator or incorrect/missing level modulation driver current to the Control Modulator. Incorrect/missing modulation driver current can indicate a failure of the A29 PCB Band 4 modulator driver circuit (U45 and U46).
E21-42 No RF Error, Band 4	This error code indicates that frequency band 4 has no RF output. The probable cause is either a defective A21 YIG Driver PCB, a defective 18 to 26.5 GHz YIG-tuned oscillator, or a defective Band 4 Control Modulator. If this is a multi-band unit, check also for correct operation of the Main RF Mux PIN Switch. Faulty operation of the switch may be caused by incorrect or missing driver current from the A 29 PCB's 18 to 26.5 GHz switch driver circuit (U29B and Q3).
E21-43 FM Path Error, Band 4	This error code indicates that the FM Driver circuitry on the A21 YIG Driver PCB is defective.

Table 6Q-3. Microwave Deck Troubleshooting (3 of 3)

Trouble / Error Code	Troubleshooting Procedure
E21-51 Unleveled Error, Band 5	This error code indicates that the frequency band 5 RF output is unleveled. The probable cause is either a defective Band 3 (12.4 to 20 GHz) Control Modulator or incorrect/missing level modulation driver current to the Control Modulator. Incorrect/missing modulation driver current can indicate a failure of the A29 PCB Band 3 modulator driver circuit (U44 and U46).
E21-52 No RF Error, Band 5	This error code indicates that frequency band 5 has no RF output. The probable cause is either a defective A20 YIG Driver PCB, a defective 12.4 to 20 GHz YIG-tuned oscillator, a defective Band 3 Control Modulator, or a defective Frequency Doubler/Amplifier. If this is a multi-band unit, check also for correct operation of the DPDT PIN Switch and the Main RF Mux PIN Switch. Faulty operation of the DPDT PIN Switch may be caused by incorrect or missing driver current from the A29 PCB's spare driver circuits (U33B, U34A, U34B, U34C, U34D, and U34E). Faulty operation of the Main RF Mux PIN Switch may be caused by incorrect or missing driver current from the A29 PCB's 12.4 to 20 GHz switch driver circuit (U29D and Q4).
E21-53 FM Path Error, Band 5	This error code indicates that the FM Driver circuitry on the A20 YIG Driver PCB is defective.


FREQUENCY DOUBLER
(40 GHz Models)
SAMPLER
SAMPLER MUX PIN SWITCH
SWITCH CONTROL
PULSE INPUT
YIG OSCILLATOR 18 - 26.5 GHz
FM
Tune
Bias
ISOLATOR
YIG OSCILLATOR 12.4 - 20 GHz
DUAL ISOLATOR
YIG OSCILLATOR 8 - 12.4 GHz
DUAL ISOLATOR
YIG OSCILLATOR 2 - 8.4 GHz
ATTENUATOR
ALC INPUT
CONTROL MODULATORS
(Required with Frequency Doubler)
HIGH POWER AMPLIFIERS (Optional)
DPDT PIN SWITCH
12.4 - 20 GHz
8 - 12.4 GHz
13.25 - 20 GHz
8 - 20 GHz
SWITCH CONTROL
ATTENUATOR
FREQUENCY DOUBLER/AMP
X2
26.5 - 40 GHz
40 GHz LPF
26.5 GHz LPF
20 GHz LPF
8 GHz LPF*
MAIN RF OUTPUT MUX PIN SWITCH 40 GHz Models
0.01 - 40 GHz
SWITCH CONTROL
18 - 26.5 GHz
12.4 - 20 GHz
8 - 12.4 GHz
DOWN CONVERTER
4.51 - 6.5 GHz
LPF
X9
500 MHz
LEVEL CONTROL
2 - 8.0 GHz*
0.01 - 2 GHz
SWITCHED FILTER
3.5 GHz LPF
6 GHz LPF
0.01 - 8.0 GHz*
SWITCH CONTROL
MAIN RF OUTPUT MUX PIN SWITCH 26.5 GHz Models
26.5 GHz LPF
20 GHz LPF
13 GHz LPF
8 GHz LPF*
SWITCH CONTROL
0.01 - 26.5 GHz
DIRECTIONAL COUPLER
LEVEL CONTROL
90 or 110 dB STEP ATTENUATOR (Optional)
RF OUTPUT 0.01 - 40 GHz

*8.4 GHz for 6717A and 6719A

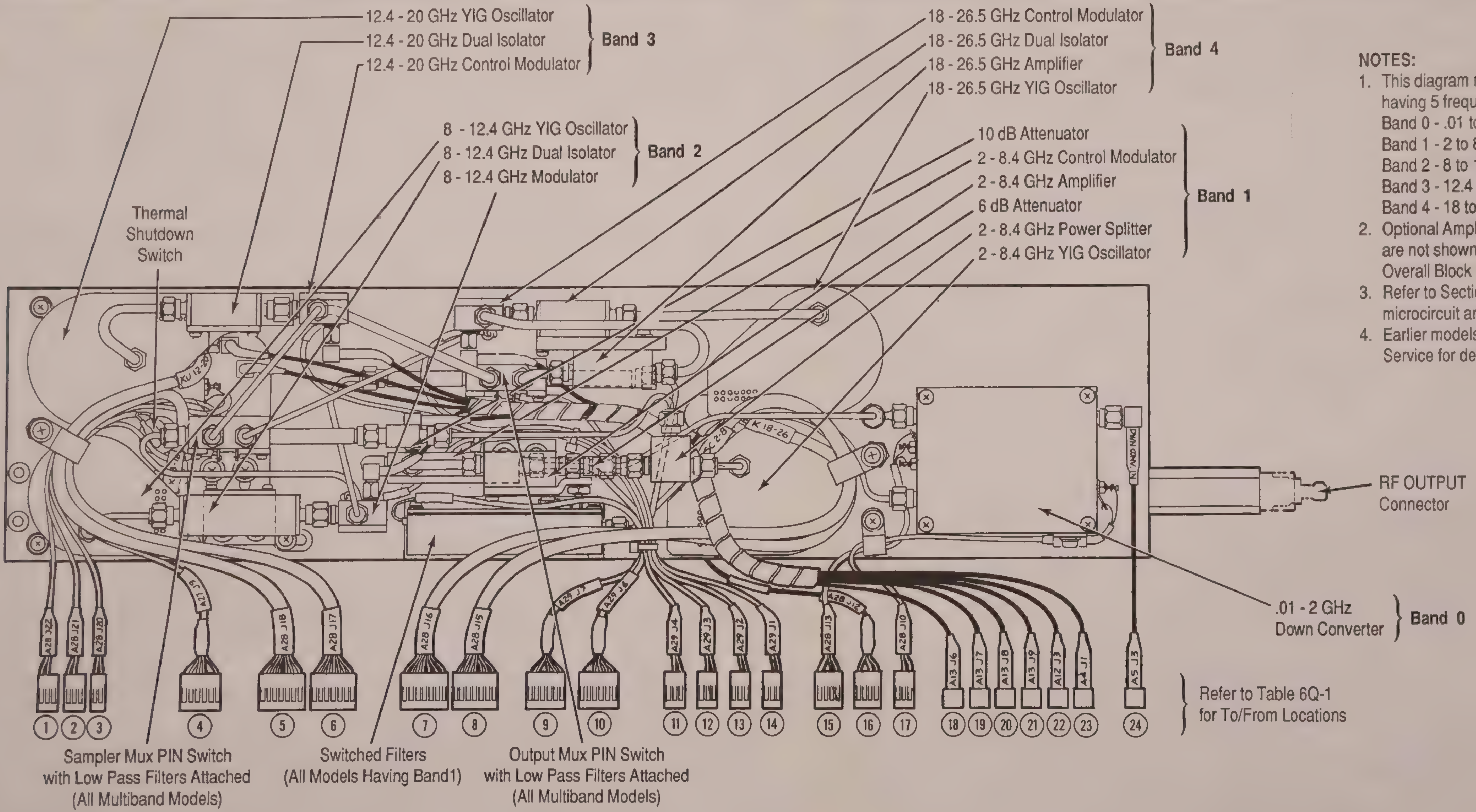
Figure 6Q-1. RF Microwave Deck Block Diagram

RF Microwave Deck Connections

Diagram Number	From/To Connection	Purpose
1	A28J22 to A31 Power Amplifier/Multiplier PCB	+15V LP Power
2	A28J21 to A30 Sampler/IF Amplifier PCB	+15V LP Power
3	A28J20 to Microwave Deck Thermal Shutdown Switch	Thermal Shutdown
4	A29J9 to SamplerMux PIN Switch	PIN Switch Drive
5	A28J18 to Frequency Band 4 YIG-tuned Oscillator	Bias Voltage and Tuning Current
6	A28J17 to Frequency Band 3 YIG-tuned Oscillator	Bias Voltage and Tuning Current
7	A28J16 to Frequency Band 2 YIG-tuned Oscillator	Bias Voltage and Tuning Current
8	A28J15 to Frequency Band 1 YIG-tunedOscillator	Bias Voltage and Tuning Current
9	A29J7 to the 0.01 to 8 GHz Switched Filter	Switch Drive
10	A29J6 to Main RF Mux PIN Switch	PIN Switch Drive
11	A29J4 to Frequency Band 4 Control Modulator	Modulator Drive
12	A29J3 to Frequency Band 3 Control Modulator	Modulator Drive
13	A29J2 to Frequency Band 2 Control Modulator	Modulator Drive
14	A29J1 to Frequency Band 1 Control Modulator	Modulator Drive
15	A28J13 to the Down Converter	Level and Thermal Detector Voltage to A15 ALC PCB
16	A28J12 to the Directional Coupler	Level and Thermal Detector Voltage to A15 ALC PCB
17	A28J10 to the Down Converter	±15V G Power
18	A13J6 to Frequency Band 1 Control Modulator	Pulse Modulation Drive
19	A13J7 to Frequency Band 2 Control Modulator	Pulse Modulation Drive
20	A13J8 to Frequency Band 3 Control Modulator	Pulse Modulation Drive
21	A13J9 to Frequency Band 4 Control Modulator	Pulse Modulation Drive
22	A12J3 to A30 Sampler/IF Amplifier PCB	20 to 32.1 MHz IF from A30 PCB
23	A4J1 to A31 Power Amplifier/Multiplier PCB	396 to 440 MHz from A4 PCB
24	A5J3 to Down Converter	500 MHz from Reference Loop
25	A28J22 to A31 Power Amplifier/Multiplier PCB	+15V LP Power
26	A28J21 to A30 Sampler/IF Amplifier PCB	+15V LP Power
*	A29J8 to DPDT PIN Switch	PIN Switch Drive
*	A28J11 to Doubler/Amplifier	+12V Power

* – Not Shown on this diagram. Used in 67XXA models containing frequency band 5 (26.5 to 40 GHz).

Figure 6Q-2. Typical Microwave Deck
Parts Locater Diagram
(Sheet 1 of 3; Connector Listing)


12.4 - 20 GHz YIG Oscillator
12.4 - 20 GHz Dual Isolator
12.4 - 20 GHz Control Modulator
Band 3
8 - 12.4 GHz YIG Oscillator
8 - 12.4 GHz Dual Isolator
8 - 12.4 GHz Modulator
Band 2
18 - 26.5 GHz Control Modulator
18 - 26.5 GHz Dual Isolator
18 - 26.5 GHz Amplifier
18 - 26.5 GHz YIG Oscillator
Band 4
10 dB Attenuator
2 - 8.4 GHz Control Modulator
2 - 8.4 GHz Amplifier
6 dB Attenuator
2 - 8.4 GHz Power Splitter
2 - 8.4 GHz YIG Oscillator
Band 1
Thermal Shutdown Switch
KU 12-20
K 18-26
X 2-8
RF OUTPUT Connector
.01 - 2 GHz Down Converter
Band 0
A28 J22
A28 J21
A28 J20
A27 J9
A28 J18
A28 J17
A28 J16
A28 J15
A29 J7
A29 J6
A29 J4
A29 J3
A29 J2
A29 J1
A28 J13
A28 J12
A28 J10
A13 J6
A13 J7
A13 J8
A13 J9
A12 J3
A4 J1
A5 J3
①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬
⑭
⑮
⑯
⑰
⑱
⑲
⑳
㉑
㉒
㉓
㉔
Sampler Mux PIN Switch with Low Pass Filters Attached (All Multiband Models)
Switched Filters (All Models Having Band1)
Output Mux PIN Switch with Low Pass Filters Attached (All Multiband Models)

Refer to Table 6Q-1 for To/From Locations

NOTES:

1. This diagram reflects a typical 6759A having 5 frequency bands
   Band 0 - .01 to 2 GHz
   Band 1 - 2 to 8.4 GHz
   Band 2 - 8 to 12.4 GHz
   Band 3 - 12.4 to 20 GHz
   Band 4 - 18 to 26.5 GHz
2. Optional Amplifiers for high power models are not shown. Refer to Figure 6B-1 Overall Block Diagram.
3. Refer to Section 5 Parts Lists for specific microcircuit and cable part number information.
4. Earlier models differ slightly; contact Customer Service for detailed information.

Figure 6Q-2. Typical Microwave Deck Parts Locater Diagram (Sheet 2 of 3; Top View)

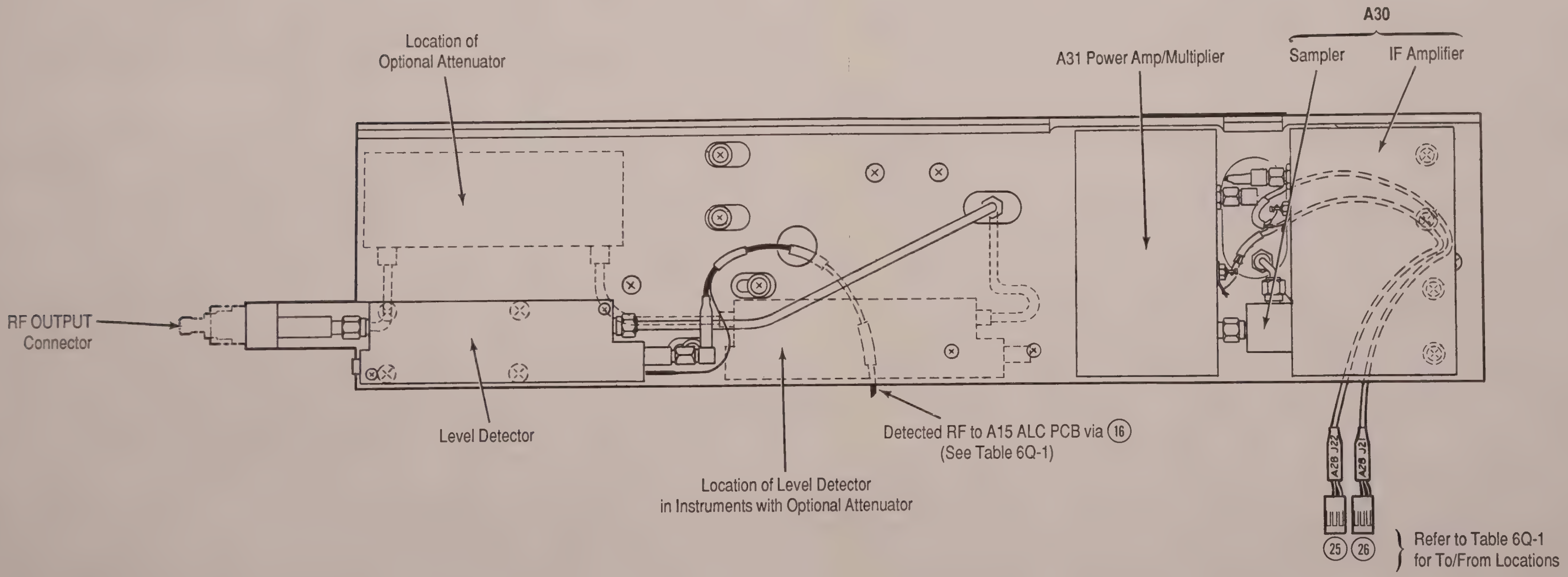

A30
Location of Optional Attenuator
A31 Power Amp/Multiplier
Sampler
IF Amplifier
RF OUTPUT Connector
Level Detector
Detected RF to A15 ALC PCB via ⑯ (See Table 6Q-1)
Location of Level Detector in Instruments with Optional Attenuator
A28 J22
A28 J21
㉕ ㉖
Refer to Table 6Q-1 for To/From Locations

Figure 6Q-2. Typical Microwave Deck Parts Locater Diagram (Sheet 3 of 3; Bottom View)

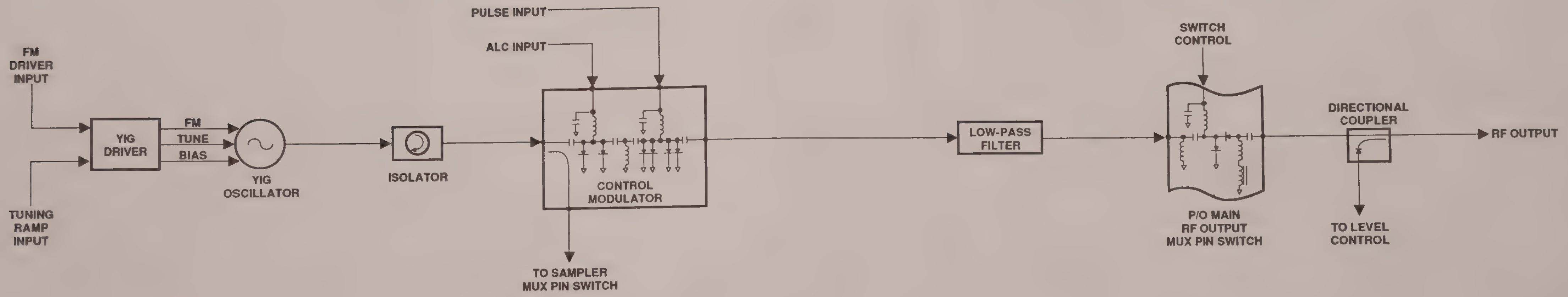
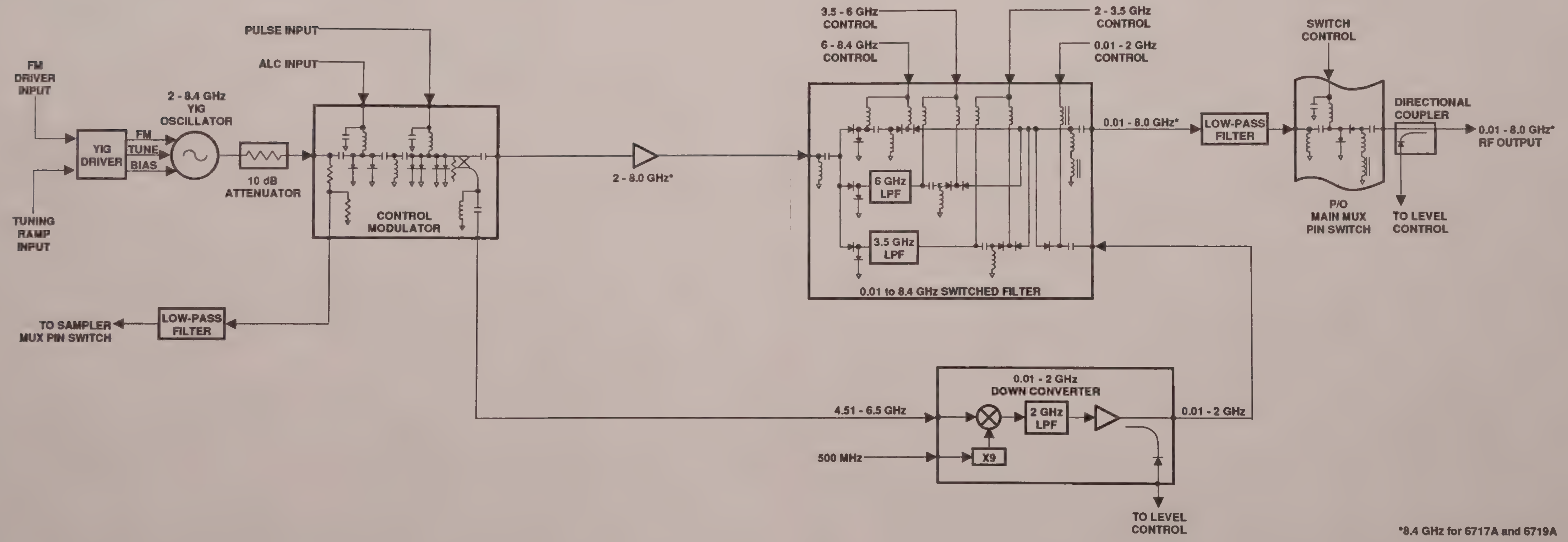
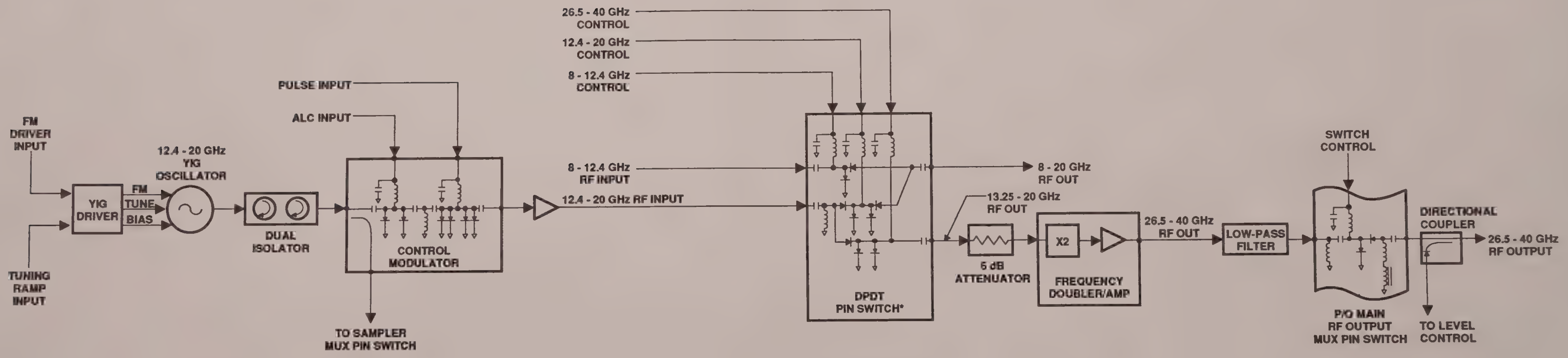

PULSE INPUT
ALC INPUT
FM DRIVER INPUT
TUNING RAMP INPUT
YIG DRIVER
FM
TUNE
BIAS
YIG OSCILLATOR
ISOLATOR
CONTROL MODULATOR
TO SAMPLER MUX PIN SWITCH
LOW-PASS FILTER
SWITCH CONTROL
P/O MAIN RF OUTPUT MUX PIN SWITCH
DIRECTIONAL COUPLER
TO LEVEL CONTROL
RF OUTPUT

Figure 6Q-3. Typical Microwave Deck Frequency Band 2, 3, or 4 Block Diagram


FM DRIVER INPUT
TUNING RAMP INPUT
YIG DRIVER
FM
TUNE
BIAS
2 - 8.4 GHz YIG OSCILLATOR
10 dB ATTENUATOR
PULSE INPUT
ALC INPUT
CONTROL MODULATOR
LOW-PASS FILTER
TO SAMPLER MUX PIN SWITCH
2 - 8.0 GHz*
3.5 - 6 GHz CONTROL
6 - 8.4 GHz CONTROL
2 - 3.5 GHz CONTROL
0.01 - 2 GHz CONTROL
6 GHz LPF
3.5 GHz LPF
0.01 to 8.4 GHz SWITCHED FILTER
0.01 - 8.0 GHz*
LOW-PASS FILTER
SWITCH CONTROL
P/O MAIN MUX PIN SWITCH
DIRECTIONAL COUPLER
0.01 - 8.0 GHz* RF OUTPUT
TO LEVEL CONTROL
0.01 - 2 GHz DOWN CONVERTER
4.51 - 6.5 GHz
500 MHz
X9
2 GHz LPF
0.01 - 2 GHz
TO LEVEL CONTROL

*8.4 GHz for 6717A and 6719A

Figure 6Q-4. Typical Microwave Deck Frequency Bands 0 and 1 Block Diagram


FM DRIVER INPUT
TUNING RAMP INPUT
YIG DRIVER
FM
TUNE
BIAS
12.4 - 20 GHz YIG OSCILLATOR
DUAL ISOLATOR
PULSE INPUT
ALC INPUT
CONTROL MODULATOR
TO SAMPLER MUX PIN SWITCH
26.5 - 40 GHz CONTROL
12.4 - 20 GHz CONTROL
8 - 12.4 GHz CONTROL
8 - 12.4 GHz RF INPUT
12.4 - 20 GHz RF INPUT
DPDT PIN SWITCH*
8 - 20 GHz RF OUT
13.25 - 20 GHz RF OUT
5 dB ATTENUATOR
X2
FREQUENCY DOUBLER/AMP
26.5 - 40 GHz RF OUT
LOW-PASS FILTER
SWITCH CONTROL
P/O MAIN RF OUTPUT MUX PIN SWITCH
DIRECTIONAL COUPLER
26.5 - 40 GHz RF OUTPUT
TO LEVEL CONTROL

*Not Used for 6740A

Figure 6Q-5. Typical Microwave Deck Frequency Band 5 Block Diagram

SECTION VII
DISASSEMBLY AND REPAIR PROCEDURES

CONTENTS

Paragraph **Title** **Page**

7-1 INTRODUCTION 7-3
7-2 DISASSEMBLY PROCEDURES 7-3
  7-2.1 Removing the Cover 7-3
  7-2.2 Removing the Front Panel 7-4
  7-2.3 Removing the Rear Panel 7-5
  7-2.4 Lowering the Microwave Deck 7-6

SECTION VII
DISASSEMBLY AND REPAIR

7-1 INTRODUCTION

The disassembly procedures in this section show how to gain access to major instrument parts for troubleshooting or maintenance.

WARNING

> Hazardous voltages are present inside the instrument when ac line power is connected. The instrument must be turned off and the line cord must be disconnected before removing any covers or panels. Repair procedures should only be performed by service persons who are fully aware of the potential hazards.

7-2 DISASSEMBLY PROCEDURES

7-2.1 Removing the Cover

1. Turn off the power. Disconnect all external cables.
2. Place the system onto the handles so that the rear panel is facing up (Figure 7-1).

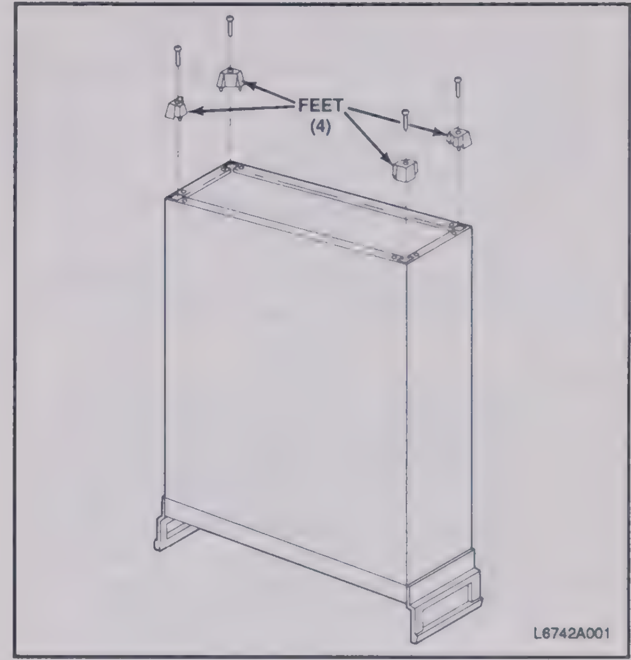

FEET
(4)
L6742A001

Figure 7-1. Removing the cover

3. Remove the four feet.
4. Remove the cover.

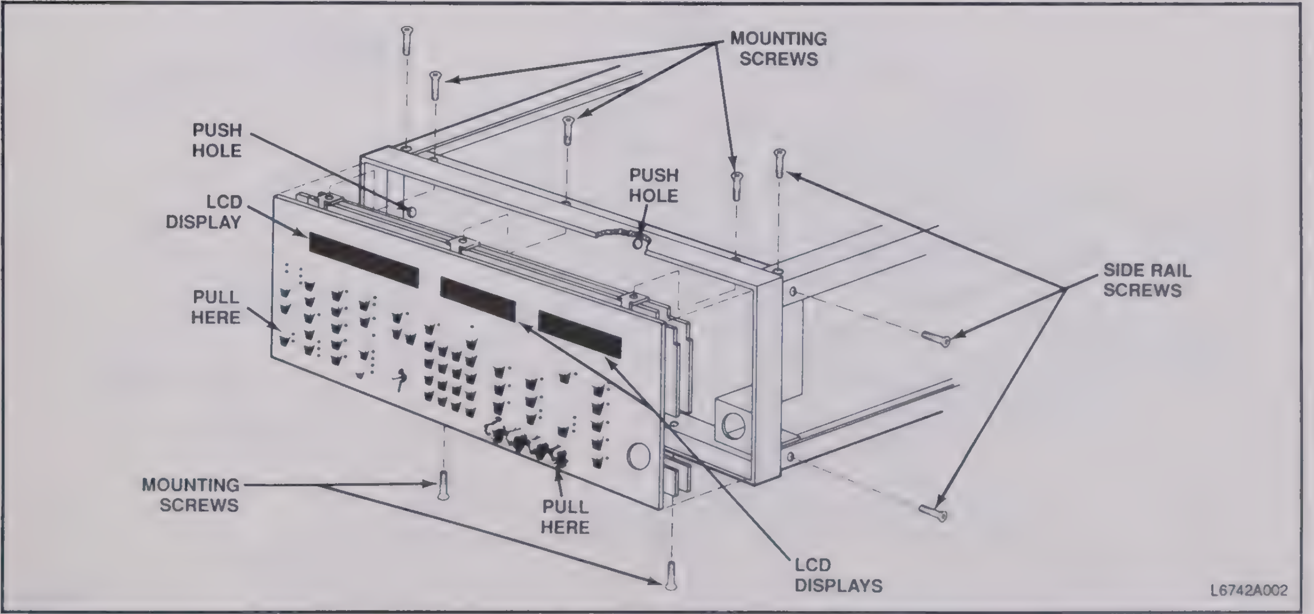

MOUNTING
SCREWS
PUSH
HOLE
LCD
DISPLAY
PUSH
HOLE
PULL
HERE
SIDE RAIL
SCREWS
MOUNTING
SCREWS
PULL
HERE
LCD
DISPLAYS
L6742A002

Figure 7-2. Front Panel Assembly and Casting

7-2.2 Removing the Front Panel

There are two aspects to removing the Front Panel: removing the front panel assembly, and removing the entire front panel casting.

a. Removing the Front Panel Assembly

1. Remove the cover as described in paragraph 7-2.1.
2. Remove the five mounting screws – three top, two bottom (see Figure 7-2).
3. Pull the front panel assembly away from the casting.
4. Unplug the three ribbon cables from the back of the front panel assembly.

NOTE

If the assembly fit is very tight and is difficult to pull out, push the assembly out from the inside of the instrument. Two holes are provided in the back of the front panel casting (see Figure 7-2). Carefully poke an insulated tool through each hole to gently force the panel assembly free.

REASSEMBLY HINT

- Apply even pressure on the four corners of the assembly as it is pushed back into place.

CAUTION

Do not push directly on the LCD Displays which are mounted into the front panel assembly; they may break.

b. Removing the Front Panel Casting

1. Remove the cover as described in paragraph 7-2.1.
2. Unplug the A13J3 cable and push it through the grommet on the chassis (Figure 7-3).
3. Turn the instrument over on its top.
4. Remove the cable shield from its mounting pins (Figure 7-4).
5. Unplug the following cables from the motherboard: A28J3, A28J4, A28J5, and A28J7.
6. Unplug all cables that connect the front panel to the motherboard.

NOTE

Remember the orientation of J1 and J2 cables; they are not keyed. WILTRON uses the following pin/color convention for the first four pins:

Pin 1 – Tan
Pin 2 – Red
Pin 3 – Orange
Pin 4 – Yellow

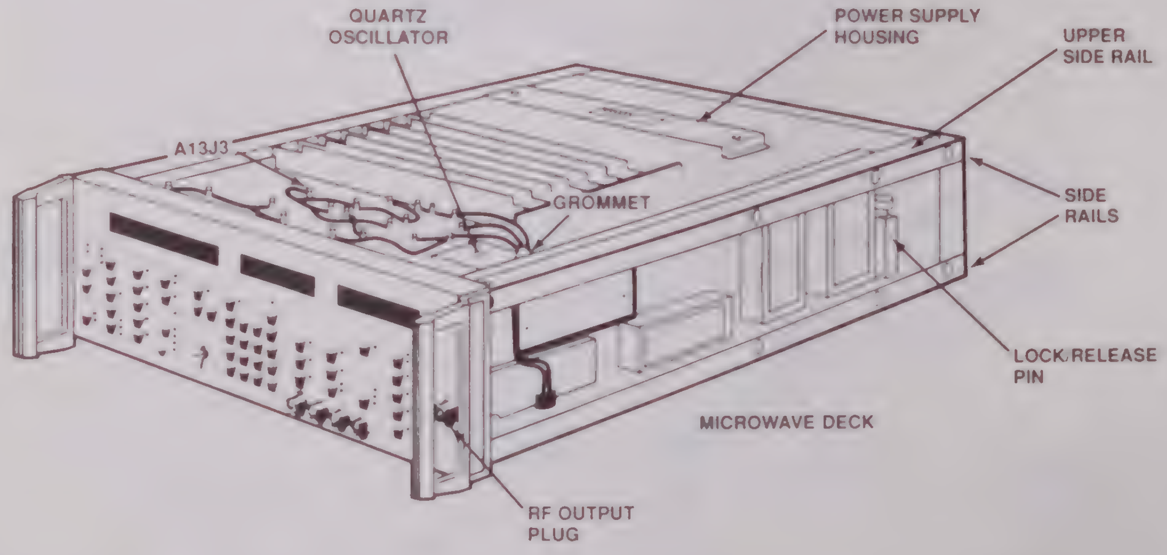


Figure 7-3. Top and Side Views

7. Remove the clamp from the A13J3 cable.
8. Remove the left and center motherboard mounting screws.
9. Lift the left-front corner of the motherboard just enough to move the A28J5 and A28J7 cables out from under the PCB.
10. Remove the mounting screw at the center of the front panel casting.
11. Remove the eight screws that secure the front panel casting to the side rails.
12. Remove the front mounting screw from the quartz oscillator housing (Figure 7-3).

CAUTION

Before sliding the front panel away from the chasis, check to ensure that the support screws are tight, and that the deck is secure (Figure 7-4).

13. Slide the front panel forward.

NOTE

If the front panel is held too tightly into place by the side rails, loosen the screws along the side rails.

CAUTION

When replacing the front panel protect the cables so they are not pinched or cut. Also, protect the RF OUTPUT connector from being damaged.

7-2.3 Removing the Rear Panel

There are two aspects to removing the rear panel: opening the rear panel to access internal components, and removing the rear panel casting for replacement or maintenance.

a. *Opening the Rear Panel*

1. Remove the cover as described on paragraph 7-2.1.
2. Turn the system over so that the bottom is accessible.
3. Unplug the cables from J25, J27, and the A28J24 fan cable (Figure 7-4).
4. Turn the system over again to make the top accessible.
5. Remove the two nuts from the back side of the power supply housing.
6. Remove the eight screws that secure the rear panel to the side rails.

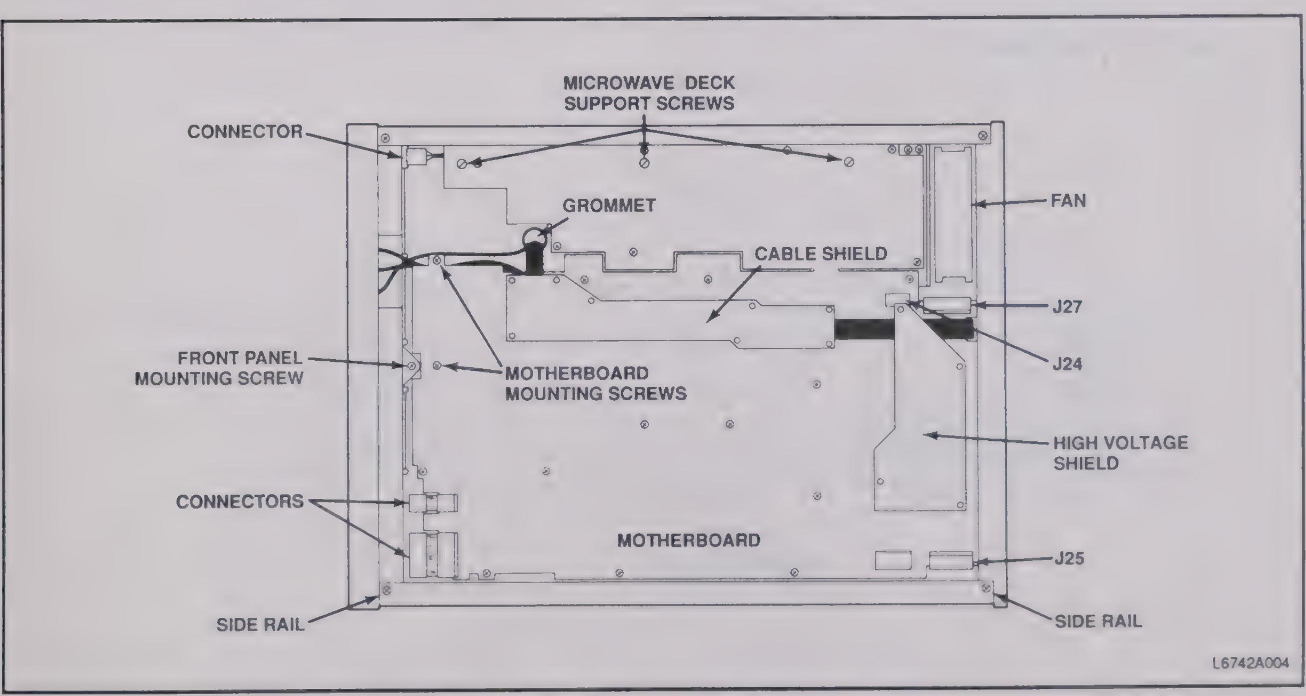

MICROWAVE DECK SUPPORT SCREWS
CONNECTOR
GROMMET
FAN
CABLE SHIELD
J27
FRONT PANEL MOUNTING SCREW
MOTHERBOARD MOUNTING SCREWS
J24
HIGH VOLTAGE SHIELD
CONNECTORS
MOTHERBOARD
J25
SIDE RAIL
SIDE RAIL
L6742A004

Figure 7-4. Bottom View

7. Slide the rear panel out of the side rails.

CAUTION

Take care to protect the cables that are still connected between the rear panel and the motherboard.

8. Remove the cable from J26 (on the top of the motherboard – not visible in Figure 7-4).
9. The rear panel is now sufficiently disassembled to allow troubleshooting and maintenance.

b. Removing the Rear Panel Casting

To completely disassemble the rear panel from the system, perform the following steps then follow the instructions in paragraph 7-2.3a.

1. Remove the cover as described in paragraph 7-2.1.
2. Looking at the top of the system, remove the cables from A13J4, A13J5, A12J2, A10J5, and A7J4.
3. Pass these cables through the grommet, to the bottom of the motherboard (Figure 7-5).
4. Turn the system over so the bottom is accessible.
5. Remove the cable and high voltage shields.
6. Unplug the A28J6, A28J8, and A28J9 cables from the motherboard.
7. Follow instructions in paragraph 7-2.3a to complete the disassembly of the rear panel.

NOTE

This technique is also useful when replacing a single cable or BNC from the rear panel.

Reassembly Hints

- When sliding the rear panel into the side rails, align the mounting bracket onto the two bolts from the power supply housing.

7-2.4 Lowering the Microwave Deck

The microwave deck is located behind the front panel RF OUTPUT connector on the right side of the 67XXA. The deck may be rotated to the side to expose its components for troubleshooting and repair. The deck is supported at the front by the front casting and at the rear by a pillow block. Three screws, accessible through the A29 Rear Panel Interface PCB at the bottom of the instrument, secure the bottom of the microwave deck. The rear support pillow block has a lock/release pin that must be lifted before rotating the deck to the side.

1. Remove the cover as described in paragraph 7-2.1.
2. Remove the screws that secure the upper side rail to the front and rear panels (Figure 7-4).

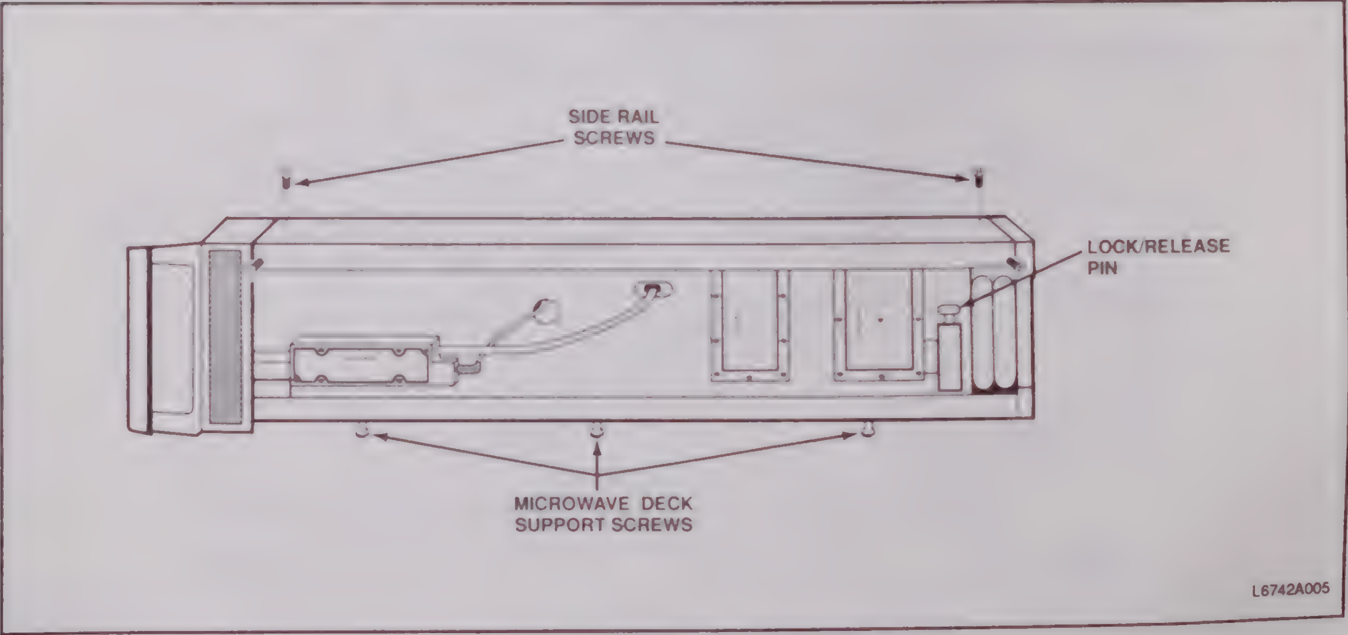


Figure 7-5. Lowering the Microwave Deck

3. Loosen the three support screws.
4. Lift the lock/release pin.
5. Turn the microwave deck out from the top until the release pin clicks into place, locking the deck in the lowered position.

Reassembly Hints

- Lift the release pin to raise the deck back into the upright position.
- Ensure the A28J16 and A28J17 cables are positioned over the nearby semi-rigid cables.
- Raise the microwave deck until the release pin clicks into place, locking the deck into the upright position.
- Tighten the support screws underneath the motherboard.
- Replace the screws that secure the upper side rail to the front and rear panels.

SECTION VIII
SPECIAL OPTIONS

CONTENTS

Paragraph	Title	Page
---	SPECIAL OPTIONS	8-1/8-2

This section is reserved for a listing
and description of any special options
that are fitted to your synthesizer.

WILTRON

1028128

www.manualsplus.com

☑ ON LOAN

☑ CAL AID

Date: 10/22/97

Customer: DGM

This unit is for or goes with:

DGM-1000

CANNOT FIND A TRAVELER

SEL QA.